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A Manual of Normal Physical Signs

By

Wyndham B. Blanton, B.A., M.A., M.D.

SECOND EDITION

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BY
WYNDHAM B. BLANTON, B.A., M.A., M.D.
RICHMOND, VIRGINIA
ASSISTANT PROFESSOR IN MEDICINE, MEDICAL COLLEGE OF VIRGINIA

SECOND EDITION

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PREFACE TO THE SECOND EDITION

In the necessity for the publication of another edition opportunity has been afforded to revise the whole text. In places it has been considerably expanded. The entire chapter on Palpation has been rewritten. It is believed that the illustrations which have been inserted will add to the clarity and usefulness of the text.

PREFACE TO THE FIRST EDITION

In the textbooks of Physical Diagnosis normal signs are so intermingled with pathologic signs that the average beginner in this subject finds himself hopelessly at sea in attempting to discover a clear description of just the normal. This brief compilation of normal findings in the healthy individual is assembled primarily to aid such students. The signs of disease are omitted. The notebook form has been adhered to for the sake of brevity. Classroom instruction is relied upon to amplify the skeletal arrangement.

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A MANUAL OF NORMAL PHYSICAL SIGNS

CHAPTER I

REGIONAL ANATOMY

For purposes of description and a better understanding of the position and relation of the organs of the body, it is customary to lay out on its surface certain arbitrary lines. These lines are both horizontal and vertical, and bear descriptive names. Thus, the *midclavicular line* is a bilateral vertical line through the middle of the clavicle. The spaces these lines enclose are similarly designated; for example, the *infraclavicular* region which lies immediately below the clavicle. The general purpose of these lines and spaces is to enable us to map out and understand the surface relations of the underlying organs with which physical diagnosis is concerned. The study of anatomic relations from this point of view is known as topographic anatomy and is naturally of basic importance in eliciting and interpreting physical signs. For such a regional study the principal facts are embodied in the accompanying tables, first of lines, then of regions, finally of contents.

LINES

Thorax

Vertical—

1. Midsternal.
2. Sternal (sternal border).
3. Midclavicular.
4. Parasternal (½ way between 2 and 3).

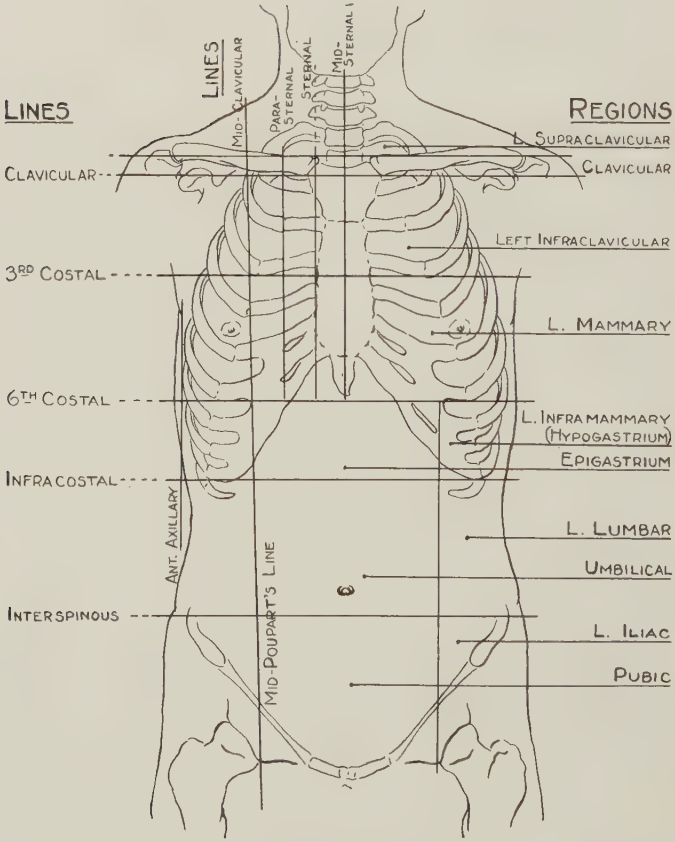

Fig. 1.—Topographic regions of the body (anterior aspect).

5. Anterior axillary (anterior axillary fold).
6. Midaxillary.
7. Posterior axillary (posterior axillary fold).
8. Scapular (inner border of scapula).
9. Posterior, mesial.

Horizontal—

1. Cricoid.
2. Clavicular.
3. Third chondrocostal juncture.
4. Sixth chondrocostal juncture.
5. Horizontal axillary (6th rib).
6. Upper scapular border.
7. Lower scapular angle.
8. Spine of 12th dorsal vertebra.

Abdomen

1. Midline.
2. Mid-Poupart's line. (Prolongation of midclavicular.)
3. Infracostal (10th costal cartilage).
4. Interspinous (between iliac spines).

Natural Lines—

1. Linea alba. (Midline symphysis to xiphoid.)
2. Lineae semilunares. (Outer border rectus.)
3. Lineae transversae (3 to navel).
4. Transverse sulci of the fat.

Thoracic Areas (Regions)

1. Supraclavicular— Above clavicular line. Below cricoid line. Lateral to sternal line.
2. Clavicular_____ Behind clavicle.

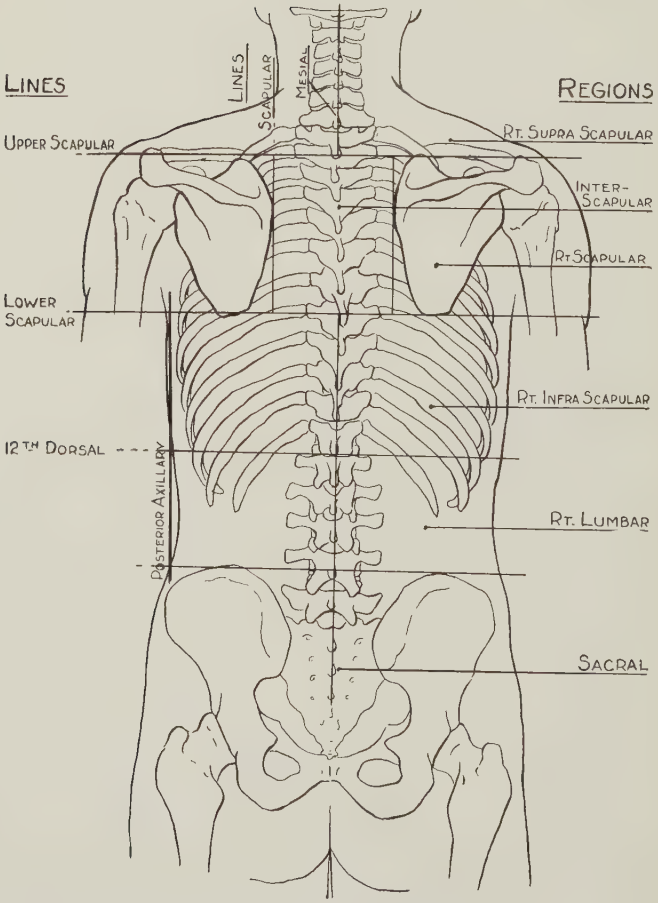

Fig. 2.—Topographic regions of the body (posterior aspect)

3. Infraclavicular — Above 3rd chondrocostal line. Below clavicular line. Lateral to sternal line.

4. Mammary — Above 6th chondrocostal line. Below 3rd chondrocostal line. Lateral to sternal line.

5. Inframammary — Below 6th chondrocostal line. Lateral to sternal line.

6. Suprasternal — Below cricoid. Above clavicular. Mesial to sternal lines.

7. Upper sternal — Below clavicular line. Above 3rd chondrocostal line. Mesial to sternal lines.

8. Lower sternal — Below 3rd chondrocostal line. Above 6th chondrocostal line. Mesial to sternal lines.

9. Axillary — Above by armpit. Below by horizontal axillary line (6th rib). Laterally by anterior and posterior axillary lines.

10. Infraaxillary — Above by horizontal axillary line. Laterally by anterior and posterior axillary lines.

11. Scapular — Above by upper scapular line. Below by lower scapular line. Mesially by scapular line.

12. Interscapular — Above by upper scapular line. Below by lower scapular line. Mesially by mesial posterior line. Laterally by scapular line.

13. Infrascapular — Above by lower scapular line. Mesially by mesial posterior line.

Abdominal Areas (Regions)

1. Hypochondrium — Above by 6th chondrocostal line. Below by infracostal line. Mesially by mid-Poupart's line.
2. Epigastrium — Above by 6th chondrocostal line. Below by infracostal line. Laterally by mid-Poupart's lines.

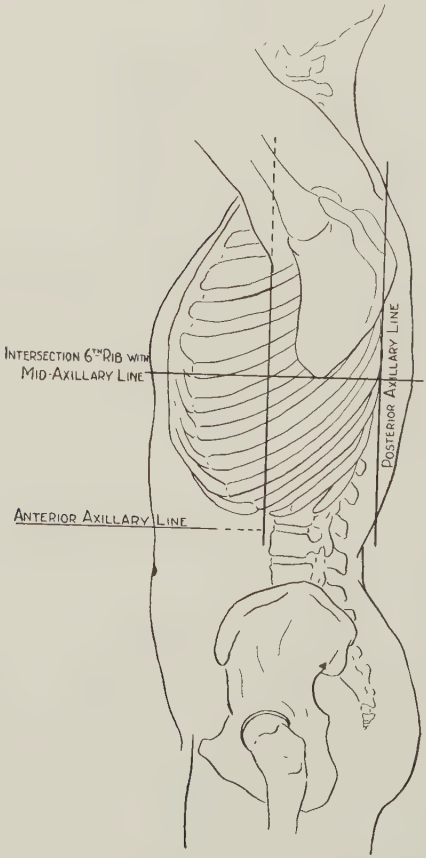

Fig. 3.—Topographic regions of the thorax (lateral aspect).

3. Lumbar	Above by infracostal line. Below by interspinous line. Mesially by mid-Poupart's line.
4. Umbilical	Above by infracostal line. Below by interspinous line. Laterally by mid-Poupart's line.
5. Iliac	Above by interspinous line. Mesially by mid-Poupart's line.
6. Pubic	Above by interspinous line. Laterally by mid-Poupart's line.
7. Upper quadrants	Above the horizontal umbilical line.
8. Lateral quadrants	To right and left of midline.
9. Posterior lumbar regions	Below costal margins. Above iliac crests. Lateral to mesial posterior line.

Topography of the Chest (Anterior)

Supraclavicular Region *(Right)*	Suprasternal Region	Supraclavicular Region *(Left)*
1. Pulmonary apex. 2. Pleura.	1. Thyroid. 2. Trachea. 3. Esophagus.	1. Pulmonary apex. 2. Pleura.
Clavicular Region *(Right)*		Clavicular Region *(Left)*
Infraclavicular Region *(Right)*	Upper Sternal Region	Infraclavicular Region *(Left)*
1. Lung (upper lobe). 2. Pleura. 3. Vena cava (superior). 4. Right auricle. 5. Primary bronchus.	1. Thymus. 2. Aortic arch. 3. Mesial pulmonary borders. 4. Esophagus.	1. Lung (upper lobe). 2. Pleura. 3. Left auricle. 4. Pulmonary artery. 5. Primary bronchus.

Mammary Region *(Right)* *(Below the 3rd rib)*	Lower Sternal Region	Mammary Region *(Left)* *(Below the 3rd rib)*
1. Lung (upper and middle lobes).	1. Right heart.	1. Lung (upper lobe).
2. Pleura.	2. Fissure between upper and middle lobes.	2. Pleura.
3. Liver (convexity).	3. Mesial border of right lung.	3. Liver.
4. Right cardiac border.	4. Esophagus.	4. Left ventricle.
		5. Right ventricle.
		6. Stomach.

Inframammary Region *(Right)* *(Below the 6th rib)*	Inframammary Region *(Left)* *(Below the 6th rib)*
1. Lung (lower lobe).	1. Lung (lower lobe).
2. Pleura.	2. Pleura.
3. Liver (right lobe).	3. Liver (left lobe).
4. Colon (transverse)?	4. Stomach (fundus).
	5. Spleen.
	6. Colon (transverse).
	7. Traube's semilunar space.

Topography of the Chest (Posterior)

Scapular Region *(Right)*	Interscapular Region	Scapular Region *(Left)*
1. Lung (upper lobe). (lower lobe).	1. Esophagus.	1. Lung (upper lobe). (lower lobe).
2. Interlobar fissure.	2. Trachea.	2. Left ventricle.
3. Pleura.	3. Primary bronchi.	3. Pleura.
	4. Great vessels.	4. Interlobar fissure.
	5. Auricles.	
	6. Heart.	
	7. Lungs (upper lobe). (lower lobe).	
	8. Pleura.	
	9. Interlobar fissure.	
	10. Lymph glands.	

Infrascapular Region *(Right)*	*(Left)*
1. Lung (lower lobe).	1. Lung (lower lobe).
2. Pleura.	2. Apex of heart.
3. Liver.	3. Spleen.
4. Kidney (upper pole).	4. Kidney (upper pole).
	5. Pleura.
	6. Stomach (fundus).

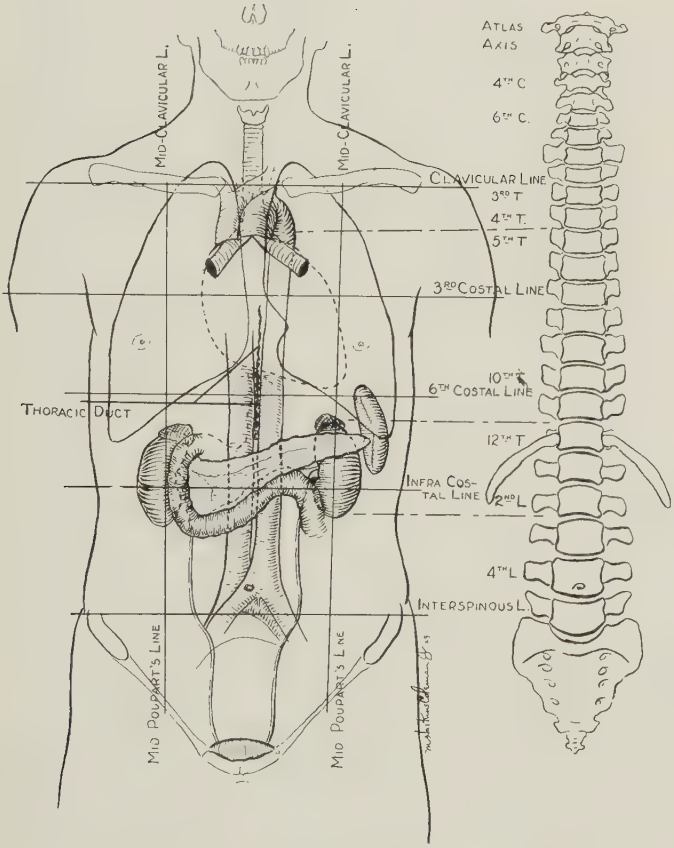

Fig. 4.—Relation of viscera to surface lines and regions, and the spinal column.

Topography of the Chest (Lateral)

Right Axillary Region	Left Axillary Region
1. Lung (upper lobe). (middle lobe). (lower lobe).	1. Lung (upper lobe). (lower lobe).
2. Pleura.	2. Pleura.
3. Interlobar fissure.	3. Interlobar fissure.
4. Heart.	4. Heart.
5. Great vessels.	5. Great vessels.
6. Trachea.	6. Trachea.
7. Bronchi.	7. Bronchi.
8. Esophagus.	8. Esophagus.
9. Liver.	9. Lymph nodes.
10. Lymph nodes.	

Right Infraaxillary Region *(Below the 6th rib)*	Left Infraaxillary Region *(Below the 6th rib)*
1. Lung (lower lobe).	1. Lung (lower lobe).
2. Pleura.	2. Pleura.
3. Liver.	3. Spleen.
4. Kidney (upper pole).	4. Stomach.
	5. Kidney (upper pole).

Abdomen (Anterior)

Right Hypochondrium	Epigastrium	Left Hypochondrium
1. Liver (right lobe).	1. Liver (right and left lobes).	1. Stomach (part).
2. Colon (hepatic flexure).	2. Gall bladder.	2. Spleen (part).
3. Kidney (part).	3. Stomach (part).	3. Pancreas (part).
	4. Duodenum.	4. Colon (splenic flexure).
	5. Pancreas.	5. Kidney (part).
	6. Spleen (part).	6. Liver (left lobe).
	7. Kidneys (part).	
	8. Adrenals.	
	9. Jejunum.	

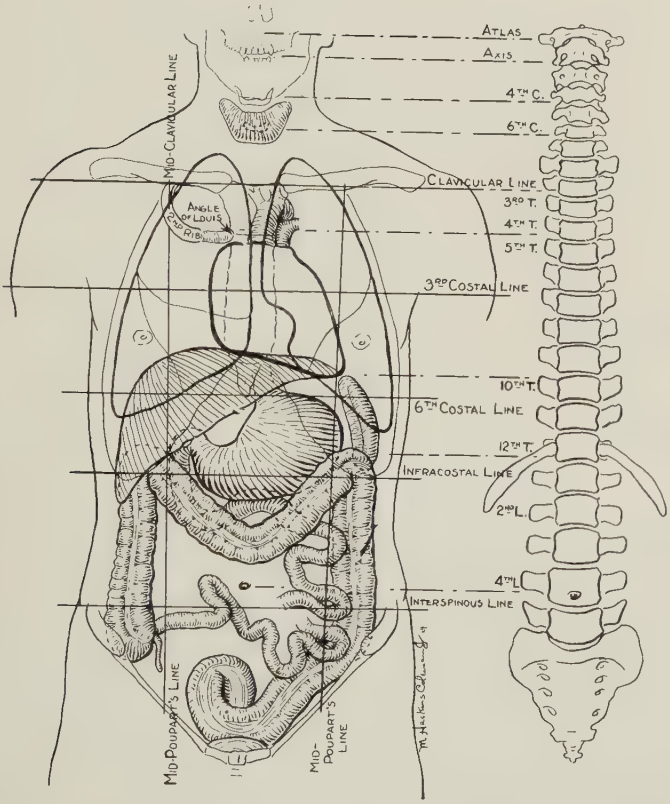

Fig. 5.—Relation of viscera to surface lines and regions, and the spinal column.

Line of the Costal Margin (10th Costal Cartilage)

Lumbar (Right)	Mid-Poupart's Line	Umbilical	Mid-Poupart's Line	Lumbar (Left)
1. Colon (ascending).		1. Colon (transverse).		1. Colon (descending).
2. Kidney (part).		2. Duodenum (part).		2. Jejunum.
3. Ileum?		3. Jejunum.		3. Kidney (part).
		4. Ileum.		
		5. Mesentery.		
		6. Omentum.		
		7. Kidney (part).		
		8. Ureters.		

Interspinous Line

Iliac (Right)	Pubic (Hypogastrium)	Iliac (Left)
1. Cecum.	1. Ileum.	1. Sigmoid.
2. Appendix.	2. Bladder (distended).	2. Jejunum.
3. Ileum.	3. Uterus (gravid).	3. Ileum.
	4. Sigmoid.	

Quadrants of the Abdomen

Right Upper Quadrant.	Left Upper Quadrant.
Umbilicus.	
Right Lower Quadrant.	Left Lower Quadrant.

Abdomen (Posterior)

(back)

Right Lumbar	Left Lumbar
1. Lumbar muscles.	1. Lumbar muscles.
2. Right kidney.	2. Left kidney (lower pole).
3. Ascending colon.	3. Descending colon.
4. Small intestine.	4. Small intestine.
5. Ureter.	5. Ureter.

The topography of each organ is discussed further under separate organs.

CHAPTER II

SOUND

Its Physics and Application to Physical Diagnosis

Sound is the most important aid to physical diagnosis.

The understanding and application of the principles of physical diagnosis are impossible without the possession of a clear knowledge of the physics of sound.

Percussion and auscultation are entirely matters of the interpretation of sound.

Sound—

The auditory perception of air waves set in motion by a body in vibration.

Source of Sound—

Any body capable of elastic vibrations.

Nature of Sound Wave—

An elastic vibration.
Transmitted in all directions.
Waves are longitudinal vibrations.
The medium may be air or any other elastic material.
Sound waves do not pass through a vacuum.
The wave path shows alternate condensation and rarefaction.

Velocity of Sound—

Independent of pitch.
Varies with temperature, humidity, and the medium.
Air—333 meters per second.

Water—1435 meters per second.
Steel—4975 meters per second.
Wood—3300 meters per second.

Reflections of Sound Occur*—

1. When waves strike a hard object or
2. When waves pass from a medium of one density to another.

Musical Sounds (tones) have an assignable pitch.

Noises—Too irregular to fix pitch.

Four Important Characteristics of Musical Sounds—

1. Intensity (loudness)—amplitude of wave.
2. Pitch—rapidity or length of wave.
3. Quality—shape of wave.
4. Duration—only used in physical diagnosis.

Intensity (Loudness)—

Least important in physical diagnosis.
Proportional to nearness and energy put into sound production.
Expresses amplitude of wave.
Sound waves may be "damped" by internal friction of air.
Sound waves may be focused or concentrated at a point by a hollow cone. (Ear and stethoscope examples.)
Loudness may be increased by resonance chambers. (Air chamber of violin.)

Pitch—

The rate of vibration of the wave varies *inversely* with the length of the wave.
The more rapid the vibration, the shorter the wave.

*Probably accounts for diminished sound over fluid in the chest.

The shorter the wave, the higher the pitch.

Extreme limits of pitch up and down cannot be heard by the human ear.

Pitch depends on vibration rate or wave length.

Range of human ear 30 to 40,000 per second.

Quality—

Two sounds of same intensity and pitch may vary.

This variation is quality.

In this way a piano, violin, the human voice exhibit quality.

The form of the sound wave determines quality.

The form of the wave varies with the waves of higher frequency (overtones) which accompany the fundamental. The more overtones, the mellower the quality.

The quality of the human voice is determined by the shape, size, and opening of the mouth, nose, and sinuses.

Duration—

This has no musical significance but the duration of sounds is used constantly in physical diagnosis.

Resonance—

Example—speaking in an empty room or into an empty jar.

A resonator reflects sounds from its inner walls.

If they are of the proper pitch for the resonator, they are reenforced by the resonator on entering its opening and may be so distinguished ("spherical resonator").

Resonators are selective, each responding to its own fundamental pitch.

Fundamental Tone—

Produced by any musical source.

The source vibrates as a whole.

It vibrates in its simplest and lowest mode.

May be produced (for example) by a stretched string drawn to one side at its middle point and released, the string vibrating more or less as a whole.

Overtones (Partials)—

Due to superimposed vibrations.

They are higher pitched than the fundamental.

They are due to the failure of the source of sound to vibrate entirely as a whole.

Thus if a stretched string is struck sharply with a hammer, it vibrates according to nodes, its several parts moving independently.

What is true of a string, applies to solids, air, and fluids.

ACOUSTICS OF THE THORAX IN PHYSICAL EXAMINATION

Sound Waves arise from disturbances in the particles of an *elastic body*. Pitch depends upon the elasticity and mass of the body. In the case of the chest, pitch chiefly depends upon mass, because its elastic walls are under atmospheric pressure. The pitch of tubes varies with their length, being low in long tubes.

Resonators—

"Ideal" resonators respond to only one tone (their own fundamental). "Soft-wall" resonators respond to other tones also. Vibrations

induced in a resonator which are not of the frequency of the resonator are said to be forced on it. The tones of a violin string are thus forced on the body of the violin. When an air space vibrates with the production of its proper tone, the vibrations are called *free* vibrations. Volumes of air confined in elastic walls respond best to their free vibrations. Vibrations which approximate its fundamental are easiest to force on it. Other vibrations are forced with difficulty. Bushnell lays great emphasis on the thorax as a resonator. His contentions are as follows: The larynx is the generator of breath sounds because in a wide-open larynx there is silence over the lung as well as over the trachea. The vocal cords act as do the reeds of a pipe organ.

Peculiarities of the Thoracic Resonator—

1. It is compound, being made up of
   (a) large pulmonary resonator.
   (b) small tracheobronchial resonator.
   The first responds to low tones.
   The second responds to high tones.
2. The pulmonary resonator contains solid structures under tension. (Alveoli, pleurae, bronchi.)

The *Fundamental* note of the thoracic resonator is low-pitched. It responds by increasing the intensity of all tones of its own pitch. It likewise shows a zone of resonance for sounds with a pitch near that of the fundamental.

1. When *percussed,* it gives out vesicular resonance which is the low-pitched sound we would expect to be amplified by the thoracic resonator. Other sounds of higher frequency to which the

resonator cannot respond are damped. Such high-pitched sounds arise from the—

(a) the pleximeter finger,
(b) the chest wall, and
(c) the bronchial tree,

and may actually represent more energy than the sound heard.

2. During *normal breathing* the respiratory murmur is heard over the chest. This is again a low-pitched sound. It is a component of the noise made by the friction of the breathing air current against the vocal cords. Only the low tones are responded to by the thoracic resonator. The high-pitched ones which are responded to by the tracheal resonator are suppressed by the pulmonary tissue which acts as an insulator.
3. During *phonation* some sounds are heard well over parts of some chests. These are the sounds of low pitch, which likewise fall in with the fundamental frequency of the thoracic resonator. This is called vocal resonance. It is heard in bass-voiced males.
4. Strong response by the resonator to vocal sounds near the fundamental pitch may set the chest wall in vibration so that it is tactilely discriminated. This is vocal fremitus.

The pitch of the resonator is determined by the volume of the air space. The larger the space, the lower the pitch. Examples: violin, viola, violoncello, bass viol. The pitch of the percussion note varies also with the size of the chest. It is thus different in man, woman, and child.

Percussion vibrations pass from anterior to posterior aspect of the chest along the course of the ribs and not in the horizontal plane.

A different explanation for the sounds of percussion and auscultation over the chest has been given by Martini. He does not consider the resonator effect of the chest important. He believes that breath sounds do not originate in the larynx but in tracheobronchial vibrations. The percussion note (normal pulmonary resonance) is a fusion of sounds arising from the chest wall as well as the lung. By graphic methods and the use of boxes as models of the chest, he has attempted to establish this theory.

The vesicular murmur he believes to be made up of vibrations from—

1. The bronchial system and
2. The sudden tensing of the alveolar cell walls.

The pitch of the percussion resonance and the vesicular murmur are almost the same.

Bronchial breathing shows a fundamental tone with a frequency of about 300 per second.

The vesicular murmur shows a frequency of 100 to 200 vibrations per second.

The pitch of the percussion note is the same as the pitch of the vesicular murmur in each individual chest.

References

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CHAPTER III

INSPECTION

Definition—Inspection is that method of examination which makes use of the sense of sight exclusively.

It is, of course, one of the oldest means employed in the study of human disease; and, with palpation, was really the only type of examination down to 1761.

It is still one of our most important methods, and this needs to be emphasized in an age when spectacular apparatus is so apt to crowd it out of our scheme of examination. The study of every patient should begin with it. Inspection should be practiced in an orderly way, beginning at the head and ending at the feet. Avoid hurry. All observations should be recorded immediately after they are made.

The student should drill himself constantly in accurate observation, forcing himself to notice minutiae, as well as larger departures from the normal. Only by training and habit can this faculty be acquired. One should fall into the practice of observing every one he meets. The opportunities of learning by this means are unlimited. Your classmates, the man in the street, the crowded theater, all afford an endless opportunity to learn. The world is a great free clinic for inspection. It is often surprising what facts one can gather from such habits. Turning to the matter of disease, you should know that simply by looking you can often recognize cretinism, goiters, myxedema, pituitary disease, rickets, acromegaly, nephritis, tabes, paralysis agitans, and numerous other diseases that are unmistakably stamped upon many with whom we come into daily contact.

Technic—

1. Have thoroughly in mind a picture of what is normal.
2. Patient's clothes off.
3. Good light.
   (a) Daylight.
      (1) Direct.
      (2) Oblique (shadows—pulsations).
   (b) Artificial light (transillumination, throat, ears, etc.).
4. Compare the two sides as you proceed.
5. Proceed orderly from head to foot.
6. Record observations as made.
7. Be careful and complete.
8. Do not hurry.

What to Observe—

1. Gait—

As the patient comes before you, note his mode of walking, the poise of the head, the swing of the arms, the position of the body and the feet. Notice the attitude in getting up from a sitting position. If uncertain have patient walk before you several times. Normal gaits vary very much and are influenced by temperament, strength, sex, size, length of arm and leg, condition of feet, and habit.

A normal gait should show—

(a) Coordination of muscles (a function of cerebellum and cord). Example of disturbance—alcohol.

(b) Absence of weakness (a function of the muscles and nerves). Example of disturbance—lead poisoning.

(c) Absence of stiffness (brain and cord). Example of disturbance—hemiplegia.

2. Posture—

The normal person should show when

(a) Standing—

Head—erect and freely movable.

Trunk—straight and free from spinal curvature.

Abdomen—not protuberant or retracted.

Legs—stands equally on both.

Feet—note both arches. No inversion.

Arms—

Hands—

(b) Sitting—

Comfortable—when in bed should be able to recline (no orthopnea).

(c) *Lying*—

Lateral—

Comfortable on either side. A tendency to lie on one side may indicate disease, especially of the side on which the patient lies.

1. To stop cough.
2. For cardiac comfort.

Prone—

May become a habit in

1. Colic.
2. Cardialgia.

Dorsal decubitus—peritonitis.

Position of head and legs—

Active posture—restless, moving.

Passive posture—weak, lax (ill).

What is Opisthotonos?

What is Emprosthotonos?

3. EXPRESSION—

Listless.
Excited.
Worried.
Stupid.

In pain.
Perturbed.
Ill.

or

Cheerful.
Happy.
Quiet.

Bright.
Intelligent.

Index of—
I—Emotions.
II—Mental condition.
Hippocratic Facies?
Risus Sardonicus?

4. NUTRITION—

Adipose—(panniculus adiposus).
Lean.
Emaciated.

5. DEVELOPMENT—

Musculature ——— { poorly developed. / well developed.

6. BONY ARCHITECTURE—

1. Cranium

Size—

(Much variation even in Caucasians except in height.)

Megacephalic—(large head).
Mesocephalic—(average head).
Microcephalic—(small head).

Symmetry—(usually asymmetrical). (Piersol, page 230.)

Left side longer.
Right side higher, etc.

Shape—

Extreme forms in Caucasians.
Racial variations.

Cephalic Index— $\frac{100 \times \text{breadth.}}{\text{length.}}$

Brachycephalic—(80+) round head.
Mesaticephalic—(75-80) average head.
Dolichocephalic—(75–) long head.
Prognathism—(projection of face).

2. Face

Leptoprosopic—(long face).
Chamaeprosopic—(broad face).
(Marked alterations in size and shape of head occur in certain diseases.)

3. Thorax

The normal chest should appear—

1. Symmetrical (usually asymmetrical).
2. Surface rounded.
3. No sharp angles or depressions.
4. Substernal angle 90°.
5. The intercostal spaces are seen only in lower chest.
6. No angulation of sternum.
7. Anteroposterior diameter less than transverse. (About ¾.)
8. Pyramidal shape.
9. Offset above by shoulder girdle in male and breasts in female.
10. Shoulder horizontal.
11. Scapulae flat and on same level.
12. Clavicles not prominent.

13. Supra- and infraclavicular fossae not deep.
14. The angle of Louis visible (2nd costo-sternal junction).

Abnormal Types—

1. Barrel (emphysema).
2. Flat and long (paralytic).
3. Pigeon (rachitic).
4. Funnel.
5. Kyphotic.
6. Asymmetry (unilateral disease).

Respiratory Movements—

1. Equal on the two sides
2. Regular.
3. Normal excursion.

Counting Ribs—

It is often necessary to identify the ribs on the surface of the body. Landmarks that are helpful are

Anteriorly—

1. The angle of Louis—2nd chondrosternal junction.
2. The male nipple—4th intercostal space.

Posteriorly—

1. The angle of the scapular—7th rib.

Laterally—

1. Highest digitations of the serratus magnus —6th rib.

4. Spine

1. Four curves.
   2 concave backward (cervical and lumbar).
   2 convex backward (thoracic and pelvic).

Thoracic spine deflected to right. (Heart and aorta.)

2. Spinous processes.
3. Movements (usually mixed).
   Extension—best in cervical and lumbar.
   Flexion—best in cervical and lumbar.
   Extension freer than flexion in neck.
   Flexion freer than extension in lumbar region.
   Lateral motion best in neck.
   Lateral motion least in lumbar.
   Rotation best in neck.
   Rotation least in lumbar.
   All of these spinal movements vary—
      1. With individual.
      2. With age.

5. Extremities

1. Symmetrical.
2. Same length.
3. Equal motion.
4. Size and surface condition.

7. Integument—

The skin is of interest not only because of skin diseases, but many systemic disorders are manifested in changes on the surface of the body.

Reliance is placed almost entirely on inspection in the study of the skin.

1. **Color—**

   Normally pinkish white. (Flesh color in the white race.)

   Due to—

      (a) Number of erythrocytes in skin.
      (b) Hemoglobin content of the erythrocytes in the skin.

(c) Thickness of integument.
(d) Pigment in skin.
(e) Number of blood vessels in skin.

PALLOR—

Pale faces occur in health.
Due to—
(a) Poverty in facial blood vessels.
(b) Thickened skin.
(c) Local vasomotor disturbance.
Inspection should never be relied upon to determine whether pallor represents anemia.
Examination of mucous membrane always helps.
No opinion should be entertained without a blood count.

PIGMENTATION—

Granules in deeper layers of epidermis.
More pronounced in brunettes.
Preference for—
Exposed parts—(face and hands).
Axillae.
Nipples.
Linea nigra.
Genitals.
Anus.
Increases in pregnancy.
Increases in sunshine (protective).
Increases in ultraviolet light therapy.

FRECKLES (EPHELIDES).

Hands and face.
Increase with red hair.
Increase in summer time.

Pigmentation determines the classification into albinos, blondes, and brunettes.

(A) Albinos—Rare.

Show absence or extreme scarcity of pigment in skin and appendages.

Hair—White, yellowish or reddish.

Iris—Pinkish or transparent.

Pupil—(Choroid)—Pinkish.

Skin—Pinkish.

Light hurts eyes, therefore often blinking.

(B) Blondes—

Small amount of pigment in skin and hair.

Hair—Various shades of yellow.

Iris—Blue to gray.

Pupil—Black.

Skin—Fair.

Areola of breast—Pale.

Vaginal mucous membrane—Pale and lacking scarlet.

Easily freckle in the sun.

(C) Brunettes—

Skin and hair contain the most pigment.

Hair—Brown to black.

Iris—Brown to black.

Pupil—Black.

Skin—Dark.

Areola of nipple—Dark.

Mucous membrane of vagina—Blue scarlet.

Whole skin turns darker with exposure to sun —tanned.

(D) Canities—

White hair whether premature or after advance of years.

Iron gray hair occurs in some young people.

Diseases with Pigmentation—

Melanosarcoma.
Addison's disease.
Hemochromatosis.
Tuberculosis.
Pediculosis, etc.

Other abnormal color changes in the skin:

Jaundice.
Cyanosis.
Redness.
Argyria.

2. **Moisture**—
   (a) Normal skin slightly moist.
   (b) Sweating—nervousness, fever.
   (c) Dry (dehydration)—diarrhea, diabetes, etc.

3. **Swellings**—Puffiness of the ankles occurs in certain women, especially in later life, and is without significance; likewise, puffiness under the eyes. This is often confused with edema.

4. **Circulation**—Examine the mucous membranes, the lips, the finger nails, the legs, the hands for absence of swelling, normal vessels, and normal color.

   Collateral circulation in venous obstruction—
   (a) Chest (obstruction in chest).
   (b) Lateral abdomen (obstruction in iliac veins).
   (c) Ventral abdomen (obstruction in portal veins).
   (d) Dendritic zone at costal margin unexplained.

5. **Scars**—(Vaccination, boils, buboes, tuberculous glands, syphilis, operation, cupping, tattooing.)

6. **Desquamation**—After injury, such as,
   (a) Sunburn.
   (b) Exanthemata.

7. **Striae**—(Pregnancy, edema, fat, tumors.)
   Also look for absence of tophi, eruptions, tropic changes, hemorrhages, etc.

8. **Mucous Membranes**—

Mouth and nose.	Anus.
Conjunctivae.	Vagina.

Lips—(For example)

Look for absence of—
   Pallor.
   Eruptions.
   Jaundice.
   Cyanosis.
   Scars, etc.

9. **Hair**—

1. **Distribution**—
   (All parts of body except palms and soles.)
   (a) *Head*—
      Usually scanty at birth.
      Whole scalp covered in young.
      Baldness tends to conform to frontalis.
      Encroachment on forehead in certain individuals.
   (b) *Face*—
      Beard of male. (Begins 16 to 17 years.)
      Scattering of long hairs in certain females.
   (c) *Axilla*—
      Both sexes. (Begins with puberty.)
      More marked in males.

(d) *Pubes*—
Both sexes. (Begins with puberty.)
Upper line of male pointed to navel.
Upper line of female straight.

(e) *Chest*—
Patch over sternum in certain males.
Rare in females (about nipple).

(f) *Abdomen*—
Midline patch joining pubic with sternal hair in certain males.
Rare in females.

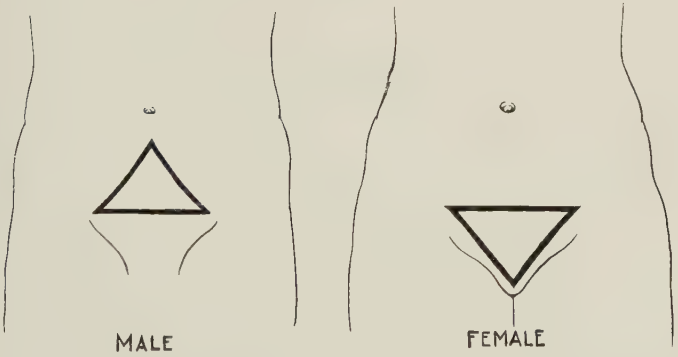

Fig. 6.—Male and female pubic hair.

(g) *Arms*—
Common on forearm of male.
Rare in female.

(h) *Hand*—
Common on ulna side of dorsum of male.

(i) *Leg*—
Common on calf, occasional on thigh of male.
Occasional in female.

(j) *Foot*—

Few on dorsum.

Brunettes tend to show more hair than blondes.

2. **Color**—

Depends on amount of pigment.

Varies from white to black.

(Albino, canities, blonde, brunette.)

3. **Sex**—

(a) Peculiar distribution.

(b) Increase in male.

4. **Age**—

Infancy. Scanty on head, lanugo on body.

Childhood. Abundant on head, lanugo on body.

Puberty. Abundant on head, changing on body.

Adult. Abundant on head, characteristic on body.

Old age. Scanty on head, characteristic on body.

(Color—whitening)

5. **Texture**—

(a) Coarse.

(b) Fine.

6. **Form**—

(a) Straight.

(b) Curls.

(c) Kinks.

7. **Amount**—

Alopecia (baldness).

Hypertrichosis (hirsuties).

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(c) Absence of stiffness (brain and cord). Example of disturbance—hemiplegia.

2. Posture—

The normal person should show when

(a) Standing—

Head—erect and freely movable.

Trunk—straight and free from spinal curvature.

Abdomen—not protuberant or retracted.

Legs—stands equally on both.

Feet—note both arches. No inversion.

Arms—

Hands—

(b) Sitting—

Comfortable—when in bed should be able to recline (no orthopnea).

(c) *Lying*—

Lateral—

Comfortable on either side. A tendency to lie on one side may indicate disease, especially of the side on which the patient lies.

1. To stop cough.
2. For cardiac comfort.

Prone—

May become a habit in

1. Colic.
2. Cardialgia.

Dorsal decubitus—peritonitis.

Position of head and legs—

Active posture—restless, moving.

Passive posture—weak, lax (ill).

What is Opisthotonos?

What is Emprosthotonos?

3. EXPRESSION—

Listless.
Excited.
Worried.
Stupid.

In pain.
Perturbed.
Ill.

or

Cheerful.
Happy.
Quiet.

Bright.
Intelligent.

Index of—
I—Emotions.
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Hippocratic Facies?
Risus Sardonicus?

4. NUTRITION—

Adipose—(panniculus adiposus).
Lean.
Emaciated.

5. DEVELOPMENT—

Musculature ---------- { poorly developed. / well developed.

6. BONY ARCHITECTURE—

1. Cranium

Size—

(Much variation even in Caucasians except in height.)

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Anteriorly—

1. The angle of Louis—2nd chondrosternal junction.
2. The male nipple—4th intercostal space.

Posteriorly—

1. The angle of the scapular—7th rib.

Laterally—

1. Highest digitations of the serratus magnus —6th rib.

4. Spine

1. Four curves.
   2 concave backward (cervical and lumbar).
   2 convex backward (thoracic and pelvic).

Thoracic spine deflected to right. (Heart and aorta.)

2. Spinous processes.
3. Movements (usually mixed).

Extension—best in cervical and lumbar.
Flexion—best in cervical and lumbar.
Extension freer than flexion in neck.
Flexion freer than extension in lumbar region.
Lateral motion best in neck.
Lateral motion least in lumbar.
Rotation best in neck.
Rotation least in lumbar.
All of these spinal movements vary—

1. With individual.
2. With age.

5. Extremities

1. Symmetrical.
2. Same length.
3. Equal motion.
4. Size and surface condition.

7. INTEGUMENT—

The skin is of interest not only because of skin diseases, but many systemic disorders are manifested in changes on the surface of the body.

Reliance is placed almost entirely on inspection in the study of the skin.

1. **Color—**

Normally pinkish white. (Flesh color in the white race.)

Due to—

(a) Number of erythrocytes in skin.
(b) Hemoglobin content of the erythrocytes in the skin.

(c) Thickness of integument.
(d) Pigment in skin.
(e) Number of blood vessels in skin.

PALLOR—

Pale faces occur in health.
Due to—
(a) Poverty in facial blood vessels.
(b) Thickened skin.
(c) Local vasomotor disturbance.
Inspection should never be relied upon to determine whether pallor represents anemia.
Examination of mucous membrane always helps.
No opinion should be entertained without a blood count.

PIGMENTATION—

Granules in deeper layers of epidermis.
More pronounced in brunettes.
Preference for—
Exposed parts—(face and hands).
Axillae.
Nipples.
Linea nigra.
Genitals.
Anus.
Increases in pregnancy.
Increases in sunshine (protective).
Increases in ultraviolet light therapy.

FRECKLES (EPHELIDES).

Hands and face.
Increase with red hair.
Increase in summer time.

Pigmentation determines the classification into albinos, blondes, and brunettes.

(A) Albinos—Rare.

Show absence or extreme scarcity of pigment in skin and appendages.

Hair—White, yellowish or reddish.

Iris—Pinkish or transparent.

Pupil—(Choroid)—Pinkish.

Skin—Pinkish.

Light hurts eyes, therefore often blinking.

(B) Blondes—

Small amount of pigment in skin and hair.

Hair—Various shades of yellow.

Iris—Blue to gray.

Pupil—Black.

Skin—Fair.

Areola of breast—Pale.

Vaginal mucous membrane—Pale and lacking scarlet.

Easily freckle in the sun.

(C) Brunettes—

Skin and hair contain the most pigment.

Hair—Brown to black.

Iris—Brown to black.

Pupil—Black.

Skin—Dark.

Areola of nipple—Dark.

Mucous membrane of vagina—Blue scarlet.

Whole skin turns darker with exposure to sun —tanned.

(D) Canities—

White hair whether premature or after advance of years.

Iron gray hair occurs in some young people.

Diseases with Pigmentation—

Melanosarcoma.
Addison's disease.
Hemochromatosis.
Tuberculosis.
Pediculosis, etc.

Other abnormal color changes in the skin:

Jaundice.
Cyanosis.
Redness.
Argyria.

2. **Moisture**—
   (a) Normal skin slightly moist.
   (b) Sweating—nervousness, fever.
   (c) Dry (dehydration)—diarrhea, diabetes, etc.

3. **Swellings**—Puffiness of the ankles occurs in certain women, especially in later life, and is without significance; likewise, puffiness under the eyes. This is often confused with edema.

4. **Circulation**—Examine the mucous membranes, the lips, the finger nails, the legs, the hands for absence of swelling, normal vessels, and normal color.
   Collateral circulation in venous obstruction—
   (a) Chest (obstruction in chest).
   (b) Lateral abdomen (obstruction in iliac veins).
   (c) Ventral abdomen (obstruction in portal veins).
   (d) Dendritic zone at costal margin unexplained.

5. **Scars**—(Vaccination, boils, buboes, tuberculous glands, syphilis, operation, cupping, tattooing.)

6. **Desquamation**—After injury, such as,
   (a) Sunburn.
   (b) Exanthemata.

7. **Striae**—(Pregnancy, edema, fat, tumors.)
   Also look for absence of tophi, eruptions, tropic changes, hemorrhages, etc.

8. **Mucous Membranes**—

Mouth and nose.	Anus.
Conjunctivae.	Vagina.

Lips—(For example)

Look for absence of—
   Pallor.
   Eruptions.
   Jaundice.
   Cyanosis.
   Scars, etc.

9. **Hair**—

1. **Distribution**—
   (All parts of body except palms and soles.)
   (a) *Head*—
      Usually scanty at birth.
      Whole scalp covered in young.
      Baldness tends to conform to frontalis.
      Encroachment on forehead in certain individuals.
   (b) *Face*—
      Beard of male. (Begins 16 to 17 years.)
      Scattering of long hairs in certain females.
   (c) *Axilla*—
      Both sexes. (Begins with puberty.)
      More marked in males.

(d) *Pubes*—
Both sexes. (Begins with puberty.)
Upper line of male pointed to navel.
Upper line of female straight.

(e) *Chest*—
Patch over sternum in certain males.
Rare in females (about nipple).

(f) *Abdomen*—
Midline patch joining pubic with sternal hair in certain males.
Rare in females.

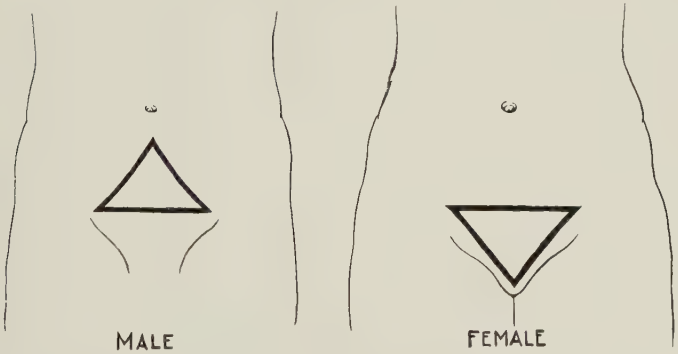

Fig. 6.—Male and female pubic hair.

(g) *Arms*—
Common on forearm of male.
Rare in female.

(h) *Hand*—
Common on ulna side of dorsum of male.

(i) *Leg*—
Common on calf, occasional on thigh of male.
Occasional in female.

(j) *Foot*—
Few on dorsum.

Brunettes tend to show more hair than blondes.

2. **Color**—

Depends on amount of pigment.
Varies from white to black.
(Albino, canities, blonde, brunette.)

3. **Sex**—

(a) Peculiar distribution.
(b) Increase in male.

4. **Age**—

Infancy. Scanty on head, lanugo on body.
Childhood. Abundant on head, lanugo on body.
Puberty. Abundant on head, changing on body.
Adult. Abundant on head, characteristic on body.
Old age. Scanty on head, characteristic on body.
(Color—whitening)

5. **Texture**—

(a) Coarse.
(b) Fine.

6. **Form**—

(a) Straight.
(b) Curls.
(c) Kinks.

7. **Amount**—

Alopecia (baldness).
Hypertrichosis (hirsuties).

Factors Influencing Fremitus--

1. Pitch of voice—low voice of the male produces it best.
2. Thickness of chest—best felt in thin chests.
3. Size of bronchus—greater with large bronchus.

Fig. 14.—Normal variations in vocal fremitus, posterior. (From Rose: *Physical Diagnosis.*)

4. Distance from source—faint in lower half of chest.
5. Respiratory phase—accentuated in inspiration.

Normally fremitus is greatest in the upper half of the chest of a thin male. It is usually more evident posteriorly and better on the right than on the left side.

Technic—

1. Patient's clothes off.
2. Patient repeats "ninety-nine."
3. Physician applies his hands lightly to the whole chest, carefully comparing the two sides and local areas with the standard infraclavicular region. He may use the tips of his fingers, the palm of his hand, or the ulnar surface. Often crossing the hands is resorted to in order to verify an impression.

Webb maintains that vocal fremitus is best detected with the back of the hand. This is due, he thinks, to bone conduction.

In mastering the art of palpation, help is not obtained from written descriptions to the same extent as in the study of percussion or auscultation. The student must in large measure find this information for himself. He must constantly practice. He should palpate every chest and abdomen he can, with great attention, making the effort to think with the ends of his fingers.

Palpation is considered again under the heading of the Abdomen.

CHAPTER V

PERCUSSION

History—Leopold Auenbrugger (1722-1809) invented and developed percussion as a method of diagnosis. His "Inventum Novum," a small work of ninety-five pages published in Latin, 1761, received scant notice at the time. Later it was translated into French by Napoleon's physician Corvisart (1808). It was, therefore, introduced just a few years before Laennec's auscultation.

Definition—Percussion is the art of eliciting and interpreting sounds produced by sharp blows struck on the surface of the body. It may be deep or light, mediate or immediate.

Uses—

1. To outline organs, as the heart, bladder, etc.
2. To determine change in position of organs.
3. To determine change in consistency, as when fluid replaces normal pulmonary tissue.
4. The following organs are accessible to examination by percussion:

Lungs.	Stomach.
Heart.	Cecum.
Kidneys.	Colon.
Spleen.	Small intestines.
Bladder.	Liver.

5. Chiefly applicable to the thorax.

Deep percussion is that type of percussion in which a hard blow is struck in order to bring out the note of a deep-seated organ.

Light percussion implies an easy blow and is used to bring out fine shades of difference in parts immediately under the finger.

Mediate percussion is that in which a plexímeter is used. A plexímeter may be a finger which is struck by another finger or a plate struck by a rubber hammer.

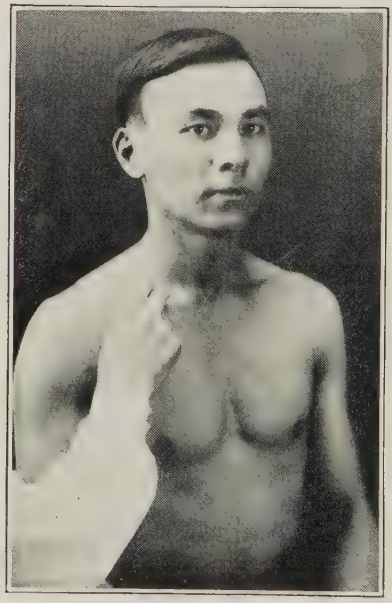

Fig. 15.—Immediate percussion. (From Rose: *Physical Diagnosis.*)

Immediate (direct) percussion is that in which no plexímeter is used. The blow is struck directly with the finger or flat of the hand.

Threshold percussion (Goldscheider) is that in which a light stroke is made over the bent second phalangeal joint of the plexímeter finger. Useful in fine discrimination.

Palpatory percussion is a combination of palpation and percussion. Stress is laid upon the sense of resistance as much as upon the sound elicited. The tips of the fingers strike the interspaces a light pushing blow.

Auscultatory Percussion—With the stethoscope applied to the surface, a series of blows is struck in the line of an arc of a circle the center of which holds the stethoscope. Sounds are much intensified and with

Fig. 16.—Mediate percussion. (From Rose: *Physical Diagnosis.*)

light percussion shades of difference are more clearly discriminated. Used chiefly in outlining such organs as the stomach.

Successful percussion means—

1. The possession of a good technic.
2. The training of oneself to listen and analyze and interpret sounds and
3. The cultivation of a sense of resistance.
   (In a quiet room. Do not be hurried. Attempt to catch and interpret each sound.)

Technic—

A. (On part of examiner.)

1. Index or middle finger of left hand with palmar surface against chest. Blow is struck with crooked middle or index finger of the other hand.
2. Ends and not pulp of percussing finger used.
3. Movement confined to wrist joint.
4. Pressure of pleximeter finger should be firm.

Fig. 17.—Auscultatory percussion. (From Rose: *Physical Diagnosis.*)

[*Function of Pleximeter.*—It really becomes a part of the chest. It compresses and pushes apart the soft parts and thus furnishes a plane or convex surface on which to receive the blow.]

5. Blows should be quickly given and quickly withdrawn. (As when "keys of pianoforte are struck.")
6. Force of blow—light or moderate. Always uniform.

7. Progress of examination from symmetrical or corresponding points.
8. Percusser should be in front of, or behind patient—not to his or her side.
9. There should be a series (5-7) of rapid blows—not 1 or 2.
10. Blow should be perpendicular.
11. Parallel to ribs.
12. Finger nail should be cut short.

B. (On part of patient.)

1. *Position*—Sitting or standing best. In bed or on table sounding board effects are often confusing.
2. *Attitude*—Must be relaxed and "act naturally."
3. Must hold himself in a symmetrical position.
4. In examining back, head should be forward, back bent and arms folded in front.

Physics of Percussion—

Of chief importance is the analysis and interpretation of the percussion note or sound. This sound, as elsewhere, has to be broken up into its constituents for description and study. We have to consider its—

1. Intensity.
2. Pitch.
3. Quality.

Intensity—Intensity is an expression for the loudness of the sound. It is dependent primarily on the energy put into the percussion stroke and is, therefore, the least important characteristic of a percussion sound.

Suppose we are percussing the left infrascapular region. The intensity of the note, or resonance as we

call it, may be feeble or loud depending on the force of the blow. There are other factors influencing intensity—

(a) "Volume of lung, and therefore, varies with the age and size of the individual,
(b) "Elasticity of costal cartilages,
(c) "The thickness of the soft parts."

Intensity is variable.

Pitch—Pitch is most important. It may be high, medium, or low. Pitch is relative. We have to compare one percussion note with another in order to express it. Thus the note over the normal lung is low. Over the lower part of the liver it may be high. Over the right apex it may be medium. These comparisons are confined to physical signs, because, of course, the high note over the liver would be low when compared to the note of a canary.

Quality—Also important. This is an individual thing. The quality of the note of percussion as heard over the lungs or the heart or the stomach or the small intestines or elsewhere is different in each locality. The quality of the pulmonary note is as characteristic as the note of the violin. The quality of the violin cannot be described other than to say it is violin quality. So of the pulmonary note. We speak of it as the *normal pulmonary resonance* or the *normal vesicular resonance* or simply *normal resonance.*

The quality of this percussion note obtained over the lungs can be imitated by percussing a loaf of bread, a sponge or inflated calves' lungs.

There is no such thing as a standard note which is the same for all normal chests, even in corresponding locations. Every individual varies in the intensity, pitch, and quality of his normal resonance. To determine, therefore, whether or not an individual chest is

normal, one has to carry in mind the average normal chest. But as disease usually attacks one side of the chest, we avail ourselves of the other side to serve as a normal for that individual.

Analysis of Various Percussion Sounds—

Quality	Pitch	Intensity	Location
Resonance (1)	Low	Variable	Lungs
Flatness (absent resonance)	High	Feeble	Liver
Dullness (diminished resonance)	Medium high	Variable	Rt. apex
Tympanitic resonance	Higher than (1)	Variable	Traube's space
Vesiculo tympanitic resonance	Higher than (1)	Increased	Emphysema
Amphoric resonance	Low	Variable	Trachea
Cracked pot (clinking)	High	Variable	Crying child

Over the chest in health we may elicit a number of percussion sounds. The most widespread note is the normal pulmonary resonance; but there are also dull, tympanitic, and even flat areas in the normal chest. It is important to remember this and to be thoroughly familiar with the regional changes in the percussion note, the chief features of which are here expressed.

Areas of Normal Pulmonary Resonance—(Chest.)

1. Left apex.
2. Right and left clavicular regions.
3. Right and left infraclavicular regions.
4. Right and left mammary regions.
5. Right and left infrascapular regions.
6. Lateral regions.
7. Interscapular (lower part) region.

Resonance = many overtones.
Tympany = fundamental.

Normal Dull Thoracic Areas—

1. Right apex.
2. Scapular region right and left (muscle).
3. Mammary region right (liver).
4. Mammary region left (heart).
5. Inframammary region left (spleen).
6. Infrascapular region (base) (liver).

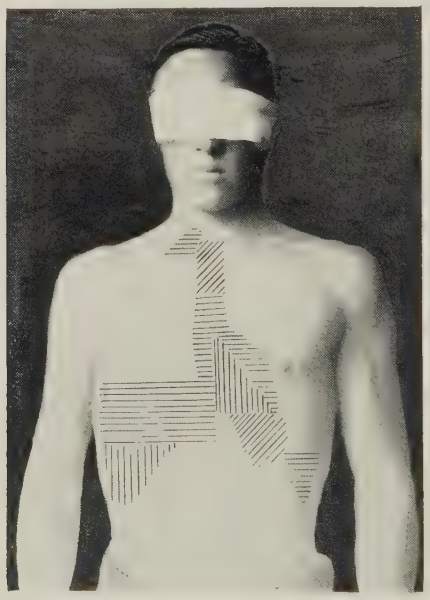

Fig. 18.—Percussion sounds heard over the normal chest (anterior). Unmarked areas, normal vesicular resonance; horizontal lines, dullness; perpendicular lines, flatness; oblique lines, tympany.

Normal Tympanitic Thoracic Areas—

1. Sternal region (upper) (trachea).
2. Traube's semilunar space (stomach).
3. Interscapular region (upper part) (trachea).
4. Infrascapular region (base) stomach *occasionally.*

Normal Flat Pulmonary Areas—

1. Right inframammary region (liver) (low).
2. Left mammary (heart).

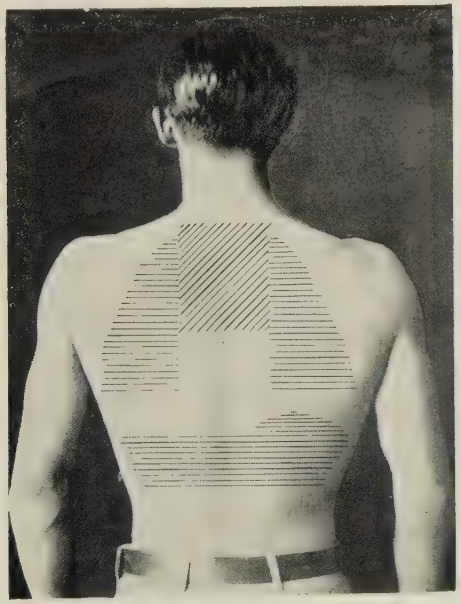

Fig. 19.—Percussion sounds heard over the normal chest (posterior.) Unmarked areas, normal vesicular resonance; horizontal lines, dullness; oblique lines, tympany.

Percussion Note Characteristic of Thoracic Areas—

1. *Supraclavicular—*
   (a) Right—dull.
   (b) Left—normal pulmonary resonance.
   (Vesiculo-tympanitic toward sternum [trachea].)
2. *Clavicular*—Right and left—normal pulmonary resonance.
   (Vesiculo-tympanitic toward sternum [trachea].)

3. *Infraclavicular*—Right and left normal pulmonary resonance.
   (Vesiculo-tympanitic toward sternum [primary bronchi].)

4. *Mammary region*—
   (a) Right.
   Diminishing resonance (increasing dullness) from 4th rib down (liver).
   (b) Left.
   Dull } over pericardium.
   Flat }

Elsewhere normal pulmonary resonance (diminished by pectoral muscles).

5. *Inframammary*—
   (a) Right—flat (liver).
   Tympanitic occasionally—(colon).
   (b) Left.
   1. Flat (liver—left lobe), close to sternum.
   2. Tympany (stomach—Traube's semilunar space, between liver and spleen).
   3. Dull (spleen), 9th to 11th ribs posterior to anterior axillary line.

6. *Sternal*—
   (a) Upper (above 2nd rib)—tympanitic.
   (b) Below the 2nd rib resonance is mixed with dullness from underlying organs.

7. *Suprascapular*—Right and left.
   Normal pulmonary resonance (though not intense).

8. *Scapular*—Right and left.
   Diminished resonance (dull).
   (Bone and muscle.)

9. *Interscapular*—Right and left.
   Resonance less than infrascapular.
   Resonance greater than scapular.
   Upper part tympanitic (trachea).
10. *Infrascapular*—
    (a) Right—Normal pulmonary resonance.
    Extreme base dull (liver).
    (b) Left—Normal pulmonary resonance.
    Extreme base occasionally tympanitic (stomach).
11. *Axillary Region*—(to 6th rib)—
    Right and left—normal pulmonary resonance.
12. *Infraaxillary Region*—
    (a) Right—dull—to flat (liver).
    (b) Left—dull (spleen)—
    tympany (stomach).

Corresponding Regions Which Are Dissimilar in Resonance—

1. Mammary.
2. Inframammary.
3. Infraaxillary.
4. Infrascapular.

Factors Influencing the Percussion Note in Health—

1. Age (changing elasticity and thickness of walls).
2. Thickness of chest wall (fat, muscles, breasts).
3. Distention of colon or stomach.
4. Lying on side (upper more resonant).
5. Respiration (more resonant in inspiration).

Webb advocates ambidextrous percussion and palpation while directly facing the patient. He believes in one blow rather than in a series of blows. Advises that the examiner go from below up.

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CHAPTER VI

AUSCULTATION

Definition—

The science of listening to and interpreting sounds made within the human body. Chiefly applicable to examination of the cardiorespiratory system.

Application—

1. Examination of the lungs (respiration, voice, whisper, cough).
2. Examination of the bronchi.
3. Examination of the pleura.
4. Examination of the heart and pericardium.
5. Examination of the aorta and other vessels.
6. Examination of the stomach and intestines.
7. Examination of the spleen and liver.
8. Examination of the pregnant uterus.
9. Examination of the esophagus.
10. Examination of the skull.

Remember: Auscultation, especially of the lungs, is most difficult to master.

It is important to know perfectly the auscultatory signs of the normal person.

Sounds which are normal when heard over one part of the body may be the signs of disease when heard elsewhere.

In mastering normal auscultatory signs, therefore, a knowledge of most of the pathologic signs has already been acquired.

History—

The Hippocratic School knew something of auscultation. Example: Hippocratic Succussion; Râles.

Nothing more was discovered until the great master Laennec's *L'Auscultation Médiate,* 1819. Laennec was the inventor of the stethoscope. He worked out a remarkable science of mediate auscultation with his new instrument, based upon a correlation of pathologic laboratory findings and bedside observation. Much has been added in the last one hundred years. Distinguished men who have added to this science are Skoda, Wintrick, Traube, and in this country, the elder Flint and Gerhardt.

Kinds of Auscultation—

1. Immediate.
2. Mediate.
3. Obstetric (study of fetal heart, placental murmurs, etc.).
4. Stroke (stroking surface with finger tips and listening to the sound).

Immediate Auscultation—

The ear (finger stopping other ear) is placed directly against the patient's body.

"Sounding Cloth"—a square of thin cloth placed between ear and patient's body for decency.

Objections—

1. Patient's sense of delicacy.
2. Doctor's sense of cleanliness.
3. Inability to reach axilla, etc.
4. Inability to localize sounds, such as cardiac murmurs.

Advantages—

1. Picks up faint bronchial breathing not audible through stethoscope (central pneumonia).
2. Aortic regurgitant murmurs (high-pitched and blowing), heard better than with stethoscope.

Comparable to low power of microscope of which stethoscope represents the high power.—Cabot.

Should always be used in the examination of the lungs.

Mediate Auscultation—

To intensify sounds and focus attention. Some form of stethoscope is used.

Fig. 20.—Monaural stethoscope. (From Rose: *Physical Diagnosis.*)

Stethoscope—

Invented by Laennec (1819).

First instrument: Straight wooden cylinder 12 inches long, 1.6 inches in diameter. Small central bore about ⅓ inch in diameter. Capable of breaking in two parts. One end plugged by removable stopper. This was a monaural stethoscope. This is type of

instrument now used in Europe. The modern monaural stethoscope is much shorter and more convenient than Laennec's.

Fig. 21.—Bowles' stethoscope. (From Rose: *Physical Diagnosis.*)

Binaural Stethoscope—

Invented by Cammann of New York. Many modern makes—Ford and Tieman, examples. Variation chiefly in chest piece. This may be:

(a) Large or small.
(b) Bell or funnel-shaped.
(c) Diaphragm. (Bowles.)

Points in Selecting a Stethoscope—

1. Try it on as you would a shoe.
2. Get a good one.
3. Get a simple one.
4. See that earpiece fits (painful if loose).
5. Tubes should be flexible and short.
6. No movable joints. No noise.
7. The proper sort of chest piece. (Funnel-shaped is best.)
8. Not too strong a spring.

Uses of a Bowles Chest Piece—

1. Children.
2. Very ill patients.
3. Aortic diastolic murmurs.

Rules for Auscultation (Thoracic)

Patient—

1. Do as doctor says.
2. Demonstrate as well as tell patient what to do.
3. Comfortable—seated or lying.
4. Breathe normally (at first).
5. Breathe with mouth open.

   The mouth should be entirely open. Breathing through the partially open mouth or nose may cause sounds which may exaggerate the bronchial element or the vesicular element. Do not relax velum palati.
6. Breathe more deeply than normally (later).
7. Inspire, expire, cough.
8. Rhythm and rate normal.
9. Relaxed.
10. Sit symmetrically.
11. Arms by side (frontal examination).
12. Arms on head (side examination).

Fig. 22.—Binaural stethoscope. (From Rose: *Physical Diagnosis.*)

13. Arms crossed over chest (back examination).
14. Keep quiet and still.

Doctor—

1. Do not move quickly from one area to another.
2. You cannot examine one spot too long.
3. Examine corresponding sides.
4. Compare them as you proceed.
5. Order (from above down).

6. Constant pressure with chest piece.
7. Take comfortable position seated.
8. Do not lean over patient (blood to ear).
9. Cultivate concentration (close eyes if necessary).
10. Learn to disregard external noises (room, street).

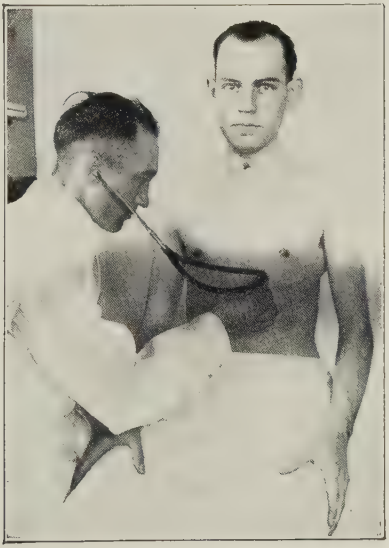


Fig. 23.—Auscultation of the thorax. (From Rose: *Physical Diagnosis.*)

Multiple Electrical Stethoscope—

1. Magnifies sound by amplifiers.
2. Electrical filters eliminate certain vibrations at will. This enables one to listen to one sound at a time.
3. Chest sounds may be reproduced by a loudspeaker.

Advantage—

Many can hear at once. (More than 500 have listened at once.)
Speaker's voice can be heard.
Closely associated sounds can be analyzed.
Otherwise inaudible sounds can be heard.
Phonographic records have been made of heart and breath sounds.*

Sources of Error During Auscultation—

(Pulmonary auscultation more difficult than cardiac.)

1. Hair crepitation (rubbing stethoscope against hair).
   (a) Synchronous with respiration.
   (b) Throughout both inspiration and expiration.
   (c) Increased by moving stethoscope.
   Confused chiefly with râles.
   Relieved by (1) Water, (2) Oil, (3) Shaving } to skin.
2. Skin friction. Relieved by firm pressure.
3. Fat in female breast. Crackling like pulmonary râles.
4. Patient scratching himself or swallowing during examination.
5. Muscle sounds. Due to
   (1) Shivering.
   (2) Voluntary contraction (trapezius).
   Characteristic—roaring.
   Can be simulated—
   (a) Close ears and contract masseters and listen.
   (b) Place stethoscope over contracting pectoral muscles.

*The Gamble-Cabot Cardiac Diagnoses records illustrate the elements of auscultation. They come in sets of nine and are to be procured from the Columbia Phonograph Co., Inc.

Where especially heard—

(1) Pectoral region (anterior).

(2) Trapezius (posterior).

Confused with—

(1) Râles.

(2) Rough breathing.

Prevented by—Examining in a warm room. Holding breath does not eliminate.

6. Not applying stethoscope evenly and firmly to chest. (One edge up, sounds from mouth get in producing effect of resonator.)
7. Hand of doctor rubbing stethoscope.
8. New or poor stethoscope.
9. In examining parts of the body difficult of access.
10. Rubber band used in obstetrical work.
11. Trouble with stethoscope.
    (a) One tube occluded.
    (b) One tube broken or cracked.
    (c) Held upside down.

Physics of Auscultation—

(See discussion of Sound.)

1. The sounds are made in the human body.
2. Vibrations are the sources of the sounds.
3. Vibrations originate in the interior and are passed through various media to the surface, where as sound waves they are picked up by the ear.
4. Sources of sound in the body.
    (a) Columns of air in motion (lungs).
    (b) Columns of fluid in motion (heart and vessels).
    (c) Muscle contraction (myocardium).
    (d) Friction of surfaces.
5. Mechanisms of sounds.
    (a) Columns of fluid or air in motion produce friction. The amount of friction varies with the

shape, size, and position of obstruction to flow, and the speed and volume of flow. Friction means vibration and vibration means sound. These factors come into play in laryngeal and tracheal and alveolar sounds, in the voice and in various murmurs.

In the chest, resonance, which depends on the size, shape, and contents of the thoracic cage, is a large factor in determining the character of respiratory and voice sounds.

(b) The vibration of the contracting myocardium is conveyed to the surface and heard as one element of the first sound of the heart.

(c) Heart valves snapping into position set up vibrations which are conveyed to the surface and distinguished as the cardiac valve sounds.

(d) Friction of one rough surface against another produces vibrations heard on the surface (pericardium, pleura, peritoneum).

(e) The slosh of fluid in body cavities likewise sets up vibrations which are often heard at a distance. (Succussion.)

(f) Popping bubbles, dislodged mucus, and the parting of sticky surfaces produce vibrations and ultimately sound. (Râles.)

Alteration of Sound—

In passing from its source within the body to the surface where they are auscultated, sounds may undergo various changes.

(a) They may be damped.

(b) They may be modified.

(c) They may be intensified (resonance).

(d) They may be obliterated.

As in the study of sound phenomena elsewhere in the body, auscultatory sounds have to be considered in terms of—

1. Intensity.
2. Pitch.
3. Quality.
4. Duration.

Normal Breath Sounds

When one applies the stethoscope to the normal chest below the scapula and listens to the double sound made by the air entering and leaving the lungs. he hears the *normal respiratory murmur.* The characteristics of this murmur are best set forth in the accompanying table.

Auscultation of the Lungs—

NORMAL VESICULAR (RESPIRATORY) MURMUR

	INSPIRATION	EXPIRATION
INTENSITY	Variable	Much less
PITCH	Low	Lower
QUALITY	Vesicular (Breezy)	Blowing*
DURATION	Whole of inspiration	Short (1/5 expiration)†

*May be imitated by blowing through mouth partly open. All of the qualities of this murmur may be studied in the lungs of the human cadaver, or of the calf or sheep.

†May be increased by forced breathing; varies in different persons.

What is it?—It is the normal breath sound heard over the greater part of the lungs in health.

Where to Study it—

1. Below the scapula.
2. Middle of anterior right chest.

How to Study it—

1. Immediate auscultation.
2. Mediate auscultation.

Information it Gives about the Lung—

1. That it is normally air containing.
2. Breathing is going on.
   Inspiration is essentially characteristic of this murmur.

Intensity of Vesicular Breathing—

Varies with depth of respiration.
Varies with spot auscultated.
Varies with thickness of chest wall.
Varies with age (puerile breathing).
Varies with disease (overworked portion).

Puerile Breathing (Childhood)—

Loud exaggerated vesicular breathing. May be confused with bronchial breathing.

Exaggerated Breathing. (Increased loudness)—

1. Thin chests.
2. After exercise.
3. Emaciation.
4. After breast amputation.

Diminished or Absent Breathing—

Sign of disease.

There have been many explanations of the mechanism of the normal respiratory murmur. Authorities differ, but each of their theories are worth knowing. An entirely satisfactory explanation is still wanting. The gist of the leading theories is given:

Theories of Breath Sounds—

1. "Acoustic expression of the friction caused by the entry of air into the pulmonary parenchyma."—Laennec.
2. Alteration of tracheal breathing by the overlying air containing lung—Bass. Certainly untrue.—Sahli.

3. Due either to distention of lung tissue or to friction of the air current in the alveoli and bronchioles (inspiration). Transmitted tracheal sound or elastic retraction of lungs (expiration).—Sahli.
4. Breath sounds are compounded of tracheobronchial vibrations and vibrations arising in the sudden tensing and relaxation of the alveolar walls in respiration.—Martini.
5. Breath sounds are low-pitched auditory vibrations made in the larynx and amplified by the thoracic resonator.—Bushnell.

Regional Variations of the Normal Respiratory Murmur

1. Infrascapular and Axillary Regions**

	Inspiration	Expiration
Intensity	Variable	Much less
Pitch	Low	Lower
Quality	Vesicular	Blowing
Duration	Whole of Inspiration	1/5 Expiration

2. Mammary Region

Intensity	Diminished	Much diminished
Pitch	Low	Lower
Quality	Vesicular	Blowing
Duration	Whole of Inspiration	1/5 Expiration

3. Scapular Region†

Intensity	Feeble	Feeble
Pitch	Low	Lower
Quality	Vesicular	Blowing
Duration	Whole of Inspiration	1/5 Expiration

4. Inframammary and Infraaxillary Regions*

Intensity	Feeble	Usually Absent
Pitch	Lower	
Quality	Vesicular	
Duration	Whole of Inspiration	

5. Infraclavicular† and Interscapular† Regions

(Sternoclavicular portion)

Intensity	Variable	Variable
Pitch	High	Higher
Quality	Bronchovesicular	Bronchovesicular
Duration	Variable	Variable

*No disparity in sides.
†Right side more bronchial.

6. Infraclavicular† Region

Intensity	Variable	Much less
Pitch	Higher‡	Lower
Quality	Less Vesicular‡	Blowing
Duration	Whole of Inspiration	----------

†Right side more bronchial.
‡Cf. infrascapular region.

Difference between Sides—

Most marked in infraclavicular regions.

Right Side—

Inspiration { Intensity—less intense. Quality—less vesicular. Pitch—higher.

Cause—Tracheal in contact with upper right lobe.

When the stethoscope is applied over the normal trachea, the double murmur that is heard during the respiratory act is known as normal laryngeal or tracheal respiration. It is identical with tubular breathing. Its characteristics are analyzed in the accompanying table.

Normal Laryngeal and Tracheal Respiration
(Tubular or bronchial breathing has the same characteristics)

	Inspiration	Expiration
Intensity	Variable	More so
Pitch	High	Higher
Quality	Tubular	Tubular
Duration	From start almost to end of inspiration	As long or longer

Due to tracheal tones coming through to surface when heard over the chest.
Varies over the same chest.
Varies with forced breathing.
Varies with thickness of chest.
Varies with dyspnea.
Varies with intensity of laryngeal murmur itself.

If one listens close to the sternum during respiration, he hears a murmur which is a combination of tubular and vesicular breathing. It is due to the

Fig. 24.—Distribution of normal bronchial and bronchovesicular breathing, anterior. (From Rose: *Physical Diagnosis.*)

proximity of lung and trachea at this point. The compromise sound is called bronchovesicular breathing. Its characteristics are as follows:

NORMAL BRONCHOVESICULAR RESPIRATION

	INSPIRATION	EXPIRATION
INTENSITY	Variable	Variable
PITCH	Medium*	Medium*
QUALITY	Vesiculotubular	Vesiculotubular
DURATION	About equal*	About equal*

*Between vesicular and bronchial.

Bronchovesicular—nearer bronchial type.
Vesiculobronchial—nearer vesicular type.

Site—

1. Right apex.
2. Infraclavicular region between nipple and sternum.
3. Interscapular region.

Fig. 25.—Distribution of normal bronchial and bronchovesicular breathing, posterior. (From Rose: *Physical Diagnosis.*)

Other Types of Breathing (Pathologic)—

Emphysematous (with barrel chest).
Asthmatic (with asthma).
Amphoric (sound of open jar).
Metamorphosing (changing).

Vesicular Breathing.

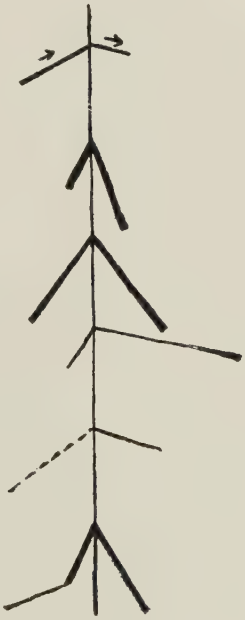
Bronchial Breathing.

Bronchovesicular Breathing.

Emphysematous Breathing.

Cogwheel Breathing.

Metamorphosing Breathing.



1. Upstroke = inspiration. Downstroke = expiration.
2. Length of stroke = length of inspiration and expiration.
3. Thickness = intensity.
4. Acuteness of angle varies with height of pitch.

Modified from Cabot.

Normal Vocal Resonance

After thoroughly studying the respiratory murmur over the whole chest, the student is prepared to take the next step which consists in having the patient say "ninety-nine" or "one, two, three," during auscultation. A characteristic resonance is made out over the trachea and thorax when this is done.

I—Tracheal and Laryngeal Voice (Normal)

Sounds heard when stethoscope is placed over

1. Larynx (thyroid cartilage)—Laryngophony.
2. Trachea (suprasternal notch)—Tracheophony.

Patient—Counting in a moderate voice, "*one, two, three,*" or saying "*ninety-nine.*"

What is heard—

1. Shock.
2. Sense of vibration.
3. Loud resonance (vocal).
4. Concentration of a near sound.
5. Articulated words transmitted (pectoriloquy).

Whisper—

1. No shock.
2. No vibration.
3. High-pitched tubular sound.
4. Articulated words transmitted (whispering pectoriloquy).

(Same as expiration in bronchial breathing—same cause.)

II—Normal Thoracic Voice

Spoken sounds ("one, two three," or "ninety-nine") as heard over the chest proper.

Technic—

1. Naked ear (other stopped).
2. Stethoscope (pressed firmly).

Note—

Normal variations on different sides.
Normal variations in different regions.
Voice sounds not as valuable as whisper sounds.
More valuable in males.
Often not heard in females.

*Standard Sounds*_____ { Below scapulae. / Middle anterior right chest.

Characteristics—

1. Diffused.
2. Distant.
3. Variable intensity. (From feeble to intense.)
4. No shock.
5. Vibration—variable.
   (Tactile to ear—not acoustic—vocal fremitus.)

Bronchophony—

Vocal sounds audible through the stethoscope over the normal bronchus.

Normal Voice Sounds by Regions—

Infraclavicular—

Intensity—more, but variable.
Diffusion—less.
Distance—nearer.
Pitch—higher.

(All comparisons with the standard region—infrascapular.)

Right side voice sounds more intense and higher pitched than the left.

Mesial aspect more intense and of a higher pitch than lateral.

Close to sternum approaches bronchophony.

(Normal bronchophony.)

(Physiologic bronchophony.)

Interscapular Region—

Intensity—greater.

Diffusion—less.

Distance—nearer.

Characteristics those of sternal end of infraclavicular region.

Right side voice sounds more intense and of higher pitch.

Axillary and Infraaxillary Regions—

Intensity—less.

Diffusion—greater.

Distance—more.

(Right side more intense and higher.)

Mammary and Inframammary Regions—

Intensity—still less.

Diffusion—still greater.

Distance—still more.

(Right side more intense and higher.)

Scapular Region—

Intensity—least.

Diffusion—greatest.

Distance—greatest.

(Right side more intense and higher.)

Pectoriloquy—Transmission of spoken words through the chest wall as recognizable words.

Egophony—Nasal tone to spoken voice heard through the stethoscope.

Normal Whispered Sounds

Having familiarized himself with vocal resonance and its regional variations, the student is now prepared to study the effect of whispered sounds over the larynx, trachea, and thorax.

I—Normal Laryngeal or Tracheal Whisper—

Site—Stethoscope placed over thyroid cartilage or suprasternal notch.

Character—

1. No shock.
2. No vibration.
3. High pitch.
4. Tubular quality.
5. Articulated words transmitted. (Whispering pectoriloquy.) Cause and character are the same as of expiration in bronchial breathing.

II—Normal Bronchial Whisper—

Definition—The type of whisper heard over the chest in health. Due to—Conduction of whispered sound principally through the air of the bronchial tubes.

Equivalent to intensified expiration. Usually produced in expiration. Pitch and quality those of expiration.

Technic—

Elicited by having patient whisper *"one, two, three,"* or *"ninety-nine."*

Auscultator should demonstrate.

Auscultator should observe usual order in examining symmetrical regions of the chest.

Some persons cannot whisper.

Some persons whisper in inspiration.

Characteristics of the Whisper by Regions—

A. *Infrascapular Region and Middle Anterior Right Chest.* (Used as standard)—

1. Intensity—feeble. (In some it cannot be heard.)
2. Pitch—low.
3. Quality—tubular.

B. *Infraclavicular Region*—

1. Intensity—variable—greater than standard.
2. Pitch—higher.
3. Quality—tubular.

The nearer the auscultator approaches the sternum, the more tracheal the sound. The right side is more tracheal than the left.

C. *Interscapular Region*—

1. Intensity—variable (cf. infraclavicular).
2. Pitch—high.
3. Quality—tubular.

D. *Scapular Region*—

1. Intensity—very feeble (frequently absent).
2. Pitch—low.
3. Quality—blowing.

E. *Mammary, Inframammary, Axillary, Infraaxillary Regions*—

Frequently absent.

When present show same characteristics as scapular region.

Pectoriloquy—"Not merely the voice but the speech is transmitted through the chest."

Whispering Pectoriloquy—

More frequent than vocal pectoriloquy.

Less apt to give error than vocal pectoriloquy.

Occurs normally—

1. Over larynx and trachea.
2. Infraclavicular region, occasionally.

Pathologic—

1. Cavity.
2. Consolidation.

Râles

Definition—Sounds heard on auscultation of the chest which may be crackling, bubbling or musical, and have as a

Cause—

Air passing through fluid.
Peeling off of sticky surfaces.
Rubbing of sticky surfaces.

Classification—(Unsatisfactory.)

Moist—

(a) Large.
(b) Medium.
(c) Fine.
(d) Crepitant.

Musical—

(a) Sonorous (large) low pitched.
(b) Sibilant(small) high pitched.

Râles are chiefly of interest in disease. They do, however, occur in health.

Râles in Health—

Site—Infraaxillary region.
Character—Crepitant.
Cause—Atelectasis of disuse.
Age—Past forty-five.
Time—End of inspiration.

Technic—

Normal breathing.
Deep breathing.
Breathe out and cough.

May be transient.

Sixty-one per cent of 365 normal chests showed these râles. (Cabot, page 160.)

Auscultation of Normal Larynx, Trachea, Bronchi—

Has been considered under the general heading of the lungs.

Auscultation of Pleura—

No sounds in health. The normal pleural surfaces are smooth and lubricated by a small amount of fluid. Movement of these surfaces upon one another in health is consequently noiseless. Roughening in disease naturally alters the conditions.

Auscultation of the Heart, vessels, and the abdominal viscera are considered in detail under the headings of those several organs.

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CHAPTER VII

CONSTITUTIONAL SIGNS

The so-called constitutional signs are exact figures expressing exact measurements. They are:

1. Temperature.
2. Pulse.
3. Respiration.
4. Blood pressure.
5. Height.
6. Weight.

1. **Temperature—**

Definition—

1. The average body temperature is the measure of the average body heat as determined by the calorimeter.
2. Local body temperature is the measure of the local temperature of the body (for example, mouth) as determined by the clinical thermometer and approximates the average body temperature.

   Hands—may be cold skin with or without fever.

   Instrument—essential.

   Expression—Fahrenheit scale—American.
   Centigrade scale—European.

Normal temperature (human)—98.6° Fahrenheit, 37° Centigrade.

Subnormal temperature—Anything below 98.6°.

Fever—Anything above 99°.

Hyperpyrexia—Anything above 104°.

Cause of Body Temperature—Heat production – heat loss = heat retained (temperature).

Alterations in temperature up or down by

1. Changes in heat production.
   (a) Increased.
   (b) Decreased.
2. Change in heat loss.
   (a) Increased.
   (b) Decreased.

Sources of Heat—

1. Oxidation in muscles (chief source).
   (a) Muscle tone.
   (b) Exercise.
   (c) Shivering.
2. Chemical change of glands during function.
3. Specific dynamic action of protein.

Heat Center—Corpus striatum controls heat production and loss.

Loss of Body Heat—

1. Conduction } ¾
2. Radiation }
3. Evaporation ¼

Varations of Temperature in Health—

1. Diurnal—(one degree lower in morning).
2. Exercise—increases heat production (300 per cent).
3. Eating—raised after a meal.
4. Excitement—
   (a) Sunday in hospital.
   (b) Bashful girls.

Best to have patient lie down 10 minutes before taking.

5. Location—
   Rectal 99.6°.
   Mouth 98.6°.
   Axilla 97.6°.

Factors influencing mouth temperature—

(a) Temperature of food previously taken.
(b) Mouth breathing.
(c) Talking.
(d) Cold air.
(e) Keeping mouth open.

6. Inheritance—Some individuals show constant slight elevation or reduction in health.
7. Age—Infants—rectum 98-99.5 normal. Holt.
   In fever higher and more labile in infancy and childhood.

Mouth Technic—

1. Shake down mercury in thermometer.
2. Lips of patient tight around thermometer.
3. Give sufficient time (1 to 3 minutes).

Malingerers may raise temperature by ——— { Friction. / Hot water. / Shaking up.

2. **Pulse**—See Blood Vessels.

3. **Respiration**—The number of respiratory excursions per minute.

Normal Rate—

Infant 44.
Child (five years) 26.
Adult 16 to 24.

Technic—

1. Count for whole minute.
2. Distract patient's attention by feeling pulse or by conversation.

3. Allow for factors which alter the normal rate.
4. (a) Usually with eye.
   (b) In difficult case, use hand on chest.

Factors which alter respiration—

1. Age. More labile and faster in childhood.
2. Excitement—increases.
3. Exercise—increases.
4. Attention—alters either way.
5. Coughing.
6. Smoking.
7. Food.
8. Gas in stomach.
9. Air inhaled (CO_2 increases).
   (O decreases).

4. **Blood Pressure—**

See page 161.

Measurements

5. **Weight—**

Value—

1. Picking the normal.
2. Diagnosis of disease which may cause loss or gain.
3. Determining progress of disease or treatment.

Scales—

1. Only the best.
2. Use same one.
3. Balance type better than spring type.

Technic—

1. Clothes off.
   If on, deduct for male—5½ pounds.
   (Shoes, sox, drawers, trousers.)

Deduct for female—2½ pounds.
(Shoes, stockings, drawers, dress.)

2. Same time of day (A. C. or P. C.).
(Meal = 1 pound.)
3. Bowel movement causes loss.

Proper Height—

White Male (in Kilos) = H (cm.) minus 1 metre. (Quetelet.)

Height must always be judged only in light of weight and age.

Mensuration

The general development varies with the height, weight, and age.

Circumferential—

Chest (at nipple line)—

1. Inspiration (average male 35⅝ inches).
2. Expiration (average male 32¾ inches).
3. Chest expansion (difference) (average male 2⅞ inches).

Good guide to nutrition. (Used in armies.)

Arm—

1. At middle of biceps.
2. At largest part of forearm.

Leg—

1. Middle of thigh.
2. Largest circumference of calf.

Abdomen—

At level of *Umbilicus*.

Head—Horizontal—
- birth 40 cm.
- 1 year 45 cm.
- puberty 50 cm.

WEIGHT TABLE

Showing Average Weight for Each Height and Age Based on "Nylic Graphic Table" by E. G. Pope

Males 20 to 55 Years of Age

Inches—	57	59	61	63	65	67	69	71	73	75
Age 20	104	111	117	125	132	140	149	158	167	177
21	105	111	118	125	133	141	150	159	168	179
22	106	112	119	126	134	142	151	160	169	180
23	106	113	119	127	135	143	152	161	170	181
24	107	114	120	128	136	144	153	162	171	182
25	108	114	121	128	136	144	154	163	172	183
26	108	115	122	129	137	145	154	164	173	184
27	109	116	122	130	138	146	155	165	174	185
28	109	116	123	130	138	147	156	166	175	186
29	110	117	124	131	139	148	157	167	176	187
30	110	117	124	132	140	148	157	167	177	187
31	111	118	125	132	140	149	158	168	178	189
32	111	118	125	133	141	150	159	169	179	189
33	112	119	126	133	142	150	159	170	179	190
34	112	119	126	134	142	151	160	170	180	191
35	112	120	127	134	143	152	161	171	181	192
36	113	120	127	135	143	152	161	172	181	193
37	113	120	128	135	144	153	162	172	182	193
38	113	121	128	136	144	153	162	173	183	194
39	114	121	129	136	145	154	163	173	183	195
40	114	122	129	136	145	154	163	173	184	195
41	114	122	129	137	146	154	164	174	184	196
42	115	122	130	138	146	155	164	174	185	196
43	115	123	130	138	146	155	165	175	185	197
44	115	123	130	138	147	155	165	175	186	197
45	116	123	131	138	147	156	165	176	186	198
46	116	123	131	139	147	156	166	176	186	198
47	116	124	131	139	148	157	166	176	187	198
48	116	124	131	139	148	157	166	177	187	199
49	117	124	131	139	148	157	167	177	187	199
50	117	124	132	140	148	157	167	177	188	199
51	117	124	132	140	149	158	167	178	188	200
52	117	125	132	140	149	158	167	178	188	200
53	117	125	132	140	149	158	168	178	188	200
54	118	125	132	140	149	158	168	178	188	200
55	118	125	132	140	149	158	168	178	188	200

Males, 15 to 20

Inches—	52	54	56	58	60	62	64	66	68	70	72
Age 15	80	87	96	104	110	116	124	131	140		
16		88	96	104	110	117	124	132	140		
17		89	97	105	111	118	125	133	141	150	
18			99	106	112	119	126	134	142	151	
19			99	107	113	120	127	135	143	152	162
20				108	114	121	128	136	144	153	163

Note: Ages fifteen to twenty are obtained by producing the curve of twenty to fifty-five. By G. J. Drolet.

WEIGHT TABLE

Showing Average Weight for Each Height and Age Based on "Nylic Graphic Table" by E. G. Pope

Females 20 to 55 Years of Age

Inches—	57	59	61	63	65	67	69	71	73
Age 20	100	106	113	120	127	134	142	152	161
21	101	107	114	120	127	135	143	152	162
22	101	107	114	121	128	135	144	153	162
23	102	108	115	122	128	137	145	154	163
24	102	108	115	122	129	137	145	155	164
25	103	109	116	123	130	138	146	155	165
26	103	110	117	124	131	139	147	156	166
27	104	110	117	124	131	139	148	157	166
28	104	111	118	125	132	140	149	158	167
29	105	111	118	126	133	141	149	158	168
30	105	112	119	126	133	141	150	159	169
31	106	112	119	127	134	142	151	160	170
32	106	113	120	127	135	143	151	161	170
33	107	113	120	128	135	143	152	162	171
34	107	114	121	129	136	144	153	162	172
35	108	115	122	129	137	145	154	163	173
36	108	115	122	130	137	146	154	164	174
37	109	116	123	130	138	146	155	165	175
38	109	116	123	131	139	147	156	166	175
39	110	117	124	131	139	148	157	166	176
40	110	117	124	132	140	148	157	167	177
41	111	118	125	132	140	149	158	168	178
42	111	118	125	133	141	150	159	169	179
43	112	119	126	134	142	150	159	169	179
44	112	119	127	134	142	151	160	170	180
45	113	120	127	135	143	152	161	171	181
46	113	120	128	136	143	152	162	171	182
47	114	121	129	136	144	153	162	172	182
48	114	121	129	137	144	154	163	173	183
49	115	122	129	138	145	154	164	174	184
50	115	122	130	138	146	155	164	174	185
51	116	123	130	139	147	156	165	175	186
52	116	123	131	139	147	156	166	176	186
53	117	124	131	140	148	157	166	177	187
54	117	124	132	140	148	158	167	177	188
55	118	125	132	140	149	158	168	178	188

Females, 15 to 20

Inches—	52	54	56	58	60	62	64	66	68	70	72
Age 15	83	88	94	100	106	113	120	127	134		
16		89	95	100	106	113	120	127	134		
17		89	95	101	107	114	121	128	135	144	
18			96	102	108	115	122	129	136	145	
19			96	102	108	115	122	129	137	146	155
20				103	109	116	123	130	138	147	156

Note: Ages fifteen to twenty are obtained by producing the curve of twenty to fifty-five. By G. J. Drolet.

Height—

Technic—

1. Against wall.
2. Erect.
3. Arms to side.
4. Heels together.
5. Shoes off.

   If on, deduct for male 1 inch.

   If on, deduct for female 2 inches.

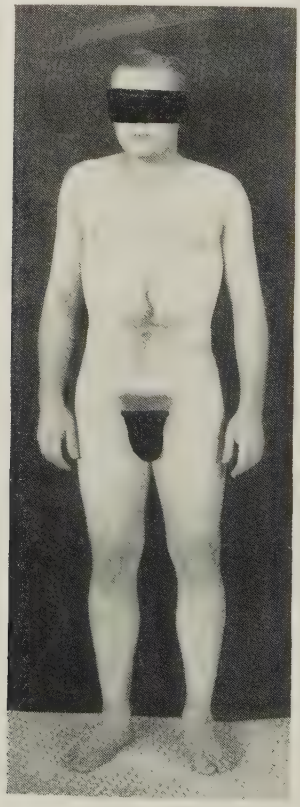

Fig. 26.—Brevilinear type.

Normal Body Proportions—

Taking the head as the unit.
Typical body 7½ heads tall.
Total height—7½ heads.
Foot—1 head.
Elbow to finger tip—2 heads.
Knee down—2 heads.
Arm—3 heads.
Umbilicus up—3 heads.
Umbilicus down—4½ heads.

Fig. 27.—Longilinear type.

Morphological Indices (Martinet)

Mediolinear (Average)	$\frac{\textit{Height}}{\text{Biaxillary diameter}}$	5.5 to 6
Brevilinear (Stocky)	$\frac{\textit{Height}}{\text{Biaxillary diameter}}$	less than 5.5
Longilinear (Slim)	$\frac{\textit{Height}}{\text{Biaxillary diameter}}$	greater than 6

Body Conformation Reflects Morphology of Heart and Great Vessels—

"Skinny body, skinny heart."

1. Diameter of chest (biaxillary) reflects diameter of aorta.
2. Blood pressure reflected in this morphology. (Longilinear and low blood pressure.)
3. Disease foreshadowed in this morphology. Examples:

Brevilinear—High blood pressure. Apoplexy. Nephritis. Metabolic disease.

Longilinear—Tuberculosis.

Certain Diseases Are Characterized by Alterations in These Normal Proportions—

Cretinism.
Chondrodystrophic dwarfs.
Rachitic dwarfs.
Gigantism.
Acromegaly.

CHAPTER VIII

HEAD, NECK AND BREAST

Every systematic examination of the body begins with the head and neck. In an effort to use the stethoscope and get at the study of the chest there is a tendency to pass hurriedly over this examination. There is also a tendency to pass superficially over the eyes, ears, nose, and throat under the impression that only a specialist is competent to do these examinations. The otoscope, the ophthalmoscope, the laryngoscope, the nasal speculum, and a light to transilluminate the sinuses should constitute a part of the equipment of every physician and he should know how to use them with confidence.

Head—

1. (a) Scalp.
   (b) Calvarium.
   (c) Brain.
2. Face.

Scalp—

1. Large number of sebaceous glands over occipito-frontalis.
2. Skin of temporal region thin.
3. Firm attachment of pericranium at suture lines.
4. Skin, fascia, aponeurosis and muscles move loosely over pericranium.
5. Vascularity.

1. *Skin*—Examine by inspection and palpation for
   (a) Color.
   (b) Smoothness.

(c) Cleanliness.
(d) Mobility.
(e) Tenderness.

2. *Hair*—

(a) Amount.
(b) Distribution.
Encroachment on forehead.
Baldness—normally occurs over aponeurosis of occipitofrontalis. Here there are fewer muscle fibers. The skin consequently lacks exercise, and the lymphatics are dependent on gravity for drainage.
(c) Color.
(d) Texture.
(e) Form.
(f) Cleanliness.

Calvarium—(Piersol.)

This is the bony brain case.

Shape—

1. *Dolichocephalic*—

(a) Long and narrow skull with often prominence of the sagittal suture. (Due to early closure of sagittal suture.)
Cephalic index below 75.

$$\text{Cephalic index } \frac{100 \times \text{breadth}}{\text{length}}$$

(b) With length due to marked occipital backward projection. (Due to many Wormian bones in Lambdoidal suture.)

2. *Brachycephalic*—
   The round, or foreshortened skull. (Due to early closure of the coronal sutures. The metopic suture [frontal] occurs only in this type of skull.)
   Index above 80.

3. *Acrocephalic*—
   High forehead—sugar-loaf type of skull. (Due to early closure of both sagittal and coronal sutures on vault.)

4. *Mesaticephalic*—
   Skull of average proportions.
   Index 75 to 80.

Size—
Megacephalic (large head).
Mesocephalic (average head).
Microcephalic (small head).

Capacity—(White race.)
Males—1220 to 1790 cubic centimeters.
Females—1090 to 1550 cubic centimeters.

Dimensions—(White race.)

	Male.	*Female.*
Length	182 mm.	174 mm.
Breadth	145 mm.	135 mm.
Height	132 mm.	125 mm.

Asymmetry—
1. Left side of cranium larger, especially in the frontal region.
2. Right side of cranium higher.
   (Cause = position of spine. The spine is not held symmetrically. The head usually rests on the left condyle.)

Effect of Age—

Circumference of head at birth 35 cm. (Holt.)
Growth first year (most rapid) 10 cm.
Growth second year 2.5 cm.
Growth second to fifth year (slow) 4 cm.
Growth after fifth year very slow.

Sutures—

Sagittal.
Coronal (2).
Lambdoidal (2).
Lateral anteroposterior (2).
Ossified six to nine months.

Fontanels—

Anterior—closed eighteenth month.
Posterior—closed second month.

Effect of Sex—

No difference before puberty.
Female skull more like the child's.
Female skull shows an angular forehead.
Female skull shows all other prominences less marked.

Effect of Race—

The white, yellow, and black races show skulls peculiar to themselves.

Landmarks of Skull—

Eminences—frontal, parietal, occipital.
External occipital protuberance—5 sinuses converge.
Bregma—junction of coronal and sagittal sutures.
Zygoma—can be felt throughout.
Temporal ridges—felt as curved lines.
Surface projections of middle meningeal artery, sinuses and ventricles important.

The Face

That part of the skull below the supraorbital eminences made up chiefly of the orbits, the nose and the jaws.

1. Color.
2. Freckles.
3. Wrinkles.
   Forehead (longitudinal and horizontal).
   From external canthus—crow's foot.
   Nasolabial.

(Cause: Loss of subcutaneous fat, age, disease or individuality.)

4. Hair (quantity and quality and distribution).
5. Texture.

Architecture of Face—

1. *Narrow Face* (Leptoprosopic).
   High orbit, narrow nose, opening directed up, palate narrow and long, lower jaw delicate, obtuse angle, row of teeth in smaller curve.
2. *Broad Face* (Chamaeprosopic).
   Low orbits, broad nasal aperture, jaw broad, square angle, edge of teeth show anteroposterior curve.

Asymmetry—

Right orbit higher.
Right eye higher and larger.
Right eye further from nose.
Right eyelid wider.
Right jaw stronger.
Right upper jaw and malar bone more prominent.
Right nostril smaller.
Nose turns to right.

Right teeth in smaller curve.
Right fold of cheek more marked.
Whole right side of face higher.

Growth—

First year face outgrows cranium.
One to five years face widens.
Five to seven years face lengthens.
Puberty—growth in all directions, but especially nose lengthens, supraorbital ridges and lower jaw increase.

Landmarks—

Supraorbital ridges.
Supraorbital notch.
Malar prominence.
Zygoma.
Condyle of inferior maxilla.
Incisor and canine fossae.
Concavity of superior maxilla (anterior wall of antrum).
Nasal bone and cartilages.

Nose*—

Size.
Shape.
Direction.
Symmetry.

Mouth*—

Size.
Shape.
Symmetry.

Ears*—

Size.
Shape.

*More fully described under Inspection.

Position.
Symmetry.

Eyes*—

Size.
Size of palpebral fissure.
Epicanthus.
Symmetry.

Neck

Generally columnar in shape. Varies with age, sex, and nutrition.

Surface Markings—

Submaxillary gland, hyoid bone, thyroid cartilage, suprasternal notch, supraclavicular fossa, sternocleidomastoid muscle, border of trapezius muscle, external jugular vein, clavicle.

Infant's neck appears short from:

1. Large head.
2. Head thrown back.
3. High clavicles.

Infant's neck wide from fat.

Short-necked persons have short plethoric bodies.

Long-necked persons have prominent larynxes and narrow flat chests.

What to Examine—

1. Size (circumference) and form.
2. Thyroid—size, shape, position, movement during swallowing, consistency, tenderness, pulsation.
3. Larynx—size, shape, position, movement during swallowing, tracheal tug.
4. Muscle—size, development.

*More fully described under Inspection.

5. Clavicle—height determines length of neck.
6. Vessels—prominence, pulsation.
7. Movement of neck—rigidity.
8. Lymph nodes—size and tenderness.
9. Vertebrae—prominence of spinous processes, tenderness.
10. Cervical rib.

Triangles of the Neck—

1. Posterior—bounded in front by sternomastoid. Divided into two—
   (a) Occipital.
   (b) Subclavian.
2. Anterior—divided into three—
   (a) Submaxillary.
   (b) Superior carotid.
   (c) Inferior carotid.

Breast

Inspection—

1. *Size*—
   (a) Absolute.
   (b) Relative.
2. *Form*—
   (a) Rotund.
   (b) Pendulous (after pregnancy).
3. *Nipples*—Size and shape.
4. *Areola*—
   (a) Size.
   (b) Color.
      1. Brunette—dark.
      2. Blonde—light.
   (c) Glands of Montgomery.

5. *Striae*_____ { after pregnancy. / after loss of fat.
6. *Veins*—

Palpation—

1. Roll whole breast under flat of hand for nodules and masses. Learn feel of normal ducts.
2. Feel for tenderness.
3. Palpate pectoral margins, axilla, supraclavicular fossa for glands.
4. Express secretion from nipple with hand or with breast pump.
5. Analyze milk.

Many breasts increase in size with the menstrual period.
Marked increase at puberty.
Marked increase with pregnancy.
Marked decrease often with age.
The two breasts are rarely of the same size.
Tender points in the breast are very common.

CHAPTER IX

RESPIRATORY SYSTEM

Lungs

Throughout the consideration of inspection, palpation, percussion and auscultation in the preceding chapters the lungs have been used purposedly to illustrate the points made. It remains necessary now only to bring these isolated procedures together and to add a few facts about the anatomy and topography of the pulmonary structures.

Object of the Pulmonary Examination—

I. To determine the size and position of the lungs.
   (a) Absolute; i.e., we must map out the pulmonary borders.
   (b) Relative; i.e., we must make comparison of the borders on the two sides.

II. To determine the mobility of the lungs.
   (a) Absolute; i.e., we must note the expansion in all diameters, and the function of the diaphragm.
   (b) Relative; i.e., we must determine whether it is equal on the two sides.

III. To determine the consistency of the lungs.
   (a) Absolute.
   (b) Relative.
   (c) General.
   (d) Local.

   Compression, fibrosis, emphysema, exudates may change the normal pulmonary consistency on one or both sides, throughout the lung, or only in a small area.

IV. To determine amount of moisture in the alveoli and bronchioles.

V. To determine the condition of the pleura.

Position and Size of the Lungs—

"A pair of conical organs, each enveloped in a serous membrane."

Fill most of the thorax.

Separated by the mediastinum.

Right larger than left (11 to 10).

The collapsed lung is ⅓ the size of the expanded lung.

Surfaces—

I. *Base* (concave)—Rests on diaphragm.

In contact below with—

1. Peritoneum.
2. Stomach.
3. Liver.
4. Spleen.
5. Kidneys.
6. Adrenals.
7. Pancreas.
8. Duodenum.
9. Inferior vena cava.
10. Celiac artery.

II. *Internal surface* (mediastinal).

In contact with—

1. Heart.
2. Structures of hilum (artery, vein, bronchus).

Right—

3. Superior vena cava.
4. Vena azygos major.
5. Right subclavian artery.
6. Esophagus.
7. Inferior vena cava.
8. Trachea.

Left—

3. Arch of aorta.
4. Left carotid artery.
5. Subclavian artery.

III. *External surface* (costal).

Lowest at back.

Includes the apex.

In contact with—

1. Subclavian artery (apex).
2. Subclavian vein (apex).
3. Ribs (thoracic wall).
4. Vertebral column.

Borders	*Lobes*
1. Anterior.	1. Superior.
2. Posterior.	2. Inferior.
3. Inferior.	3. Middle (right).

Fissures

	Chief Fissures		*Right Secondary Fissure*
	RIGHT	LEFT	
Origin	Hilum	Hilum	Behind axillary L.
Vertebral Column	5 rib	4 rib	
Axillary Line	5 i.c.s.	5 rib	5 i.c.s.
M. C. L.	6 rib	6 rib (End)	4 rib
Parasternal Line	6 rib (End)		

Inferior Pulmonary Borders—

	Right		*Left*	
		Forced Insp.		*Forced Insp.*
Sternal L.	6 c.c.	6 c.c.	6 c.c.	6 c.c.
M. C. L.	6 i.c.s.	7 rib	6 i.c.s.	7 rib
Axillary L.	8 rib	10 rib	8 rib	10 rib
Spine	11 rib	12 rib	11 rib	12 rib

Greatest descent of borders occurs in axillary line (3 to 4 cm.).

Chief factor in pulmonary expansion is increase in all diameters of chest.—(Piersol.)

Apex—

1 cm. above upper border of clavicle.

Pulmonary Weight—

Male—1300 grams. (Both.)
Female—1023 grams. (Both.)—(Krause.)

Dimensions—(Variable)—

Length—21-30 cm.
Depth—16-17 cm.
Width—11-13 cm.

Capacity—3400-3700 c.c.

Vital capacity 2500 c.c. (female) to 3700 c.c. (male).

THE APPLICATION OF (1) INSPECTION, (2) PALPATION, (3) PERCUSSION, (4) AUSCULTATION, (5) X-RAY, (6) MEASUREMENTS TO PULMONARY EXAMINATION.

Inspection—

What to look for—

I. *Evidence of the size and position of the lungs—*
   (a) Architecture of thorax. (See Inspection.)
   (b) Size of thorax.

II. *Evidence of mobility of lungs—*
   (a) Respiratory excursion (absolute and relative).
   (b) Litten's sign.
   (c) X-ray, and the fluoroscope.

III. *Evidence of consistency—*
   (a) Bony cage.
   (b) Intercostal spaces.

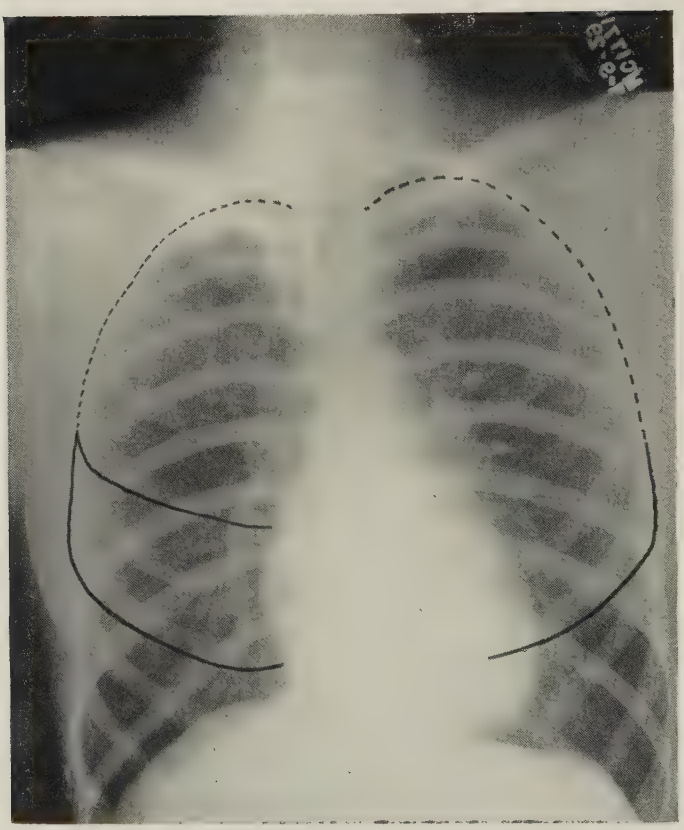

Fig. 28.—Skiagraph of the normal thorax showing the normal relations of the heart and lungs to the chest wall. The pulmonary fissures have been drawn in.

IV. *Evidence of respiratory rate and rhythm—*

Palpation—To determine—

1. Rate and rhythm of breathing.
2. Extent of respiratory excursion.
3. Relative degree of respiratory excursion.
4. Tenderness (sensitive muscle—Tbc.).

5. Smoothness or roughness of pleura.
6. Vocal fremitus.
7. Ptussic fremitus.
8. Claims of some to detect alteration in consistency (consolidated) by tactile sense.

Percussion—

1. To determine pulmonary borders.
2. To determine inferior pulmonary border.
   (a) Expiration.
   (b) Rest.
   (c) Inspiration.
   } For amount of pulmonary expansion.
3. To determine width of apex (posterior).
   Shoulder Straps—"Krönig's Isthmus."
4. To determine quality of note in each of the thoracic areas.
   (a) Comparison to be made with the normal as carried in the head.
   (b) Comparison to be made with corresponding areas of the two chests.
5. To determine resistance.
   Slapping percussion.
   Immediate percussion.
   Mediate percussion.

Auscultation—

What to listen for—

1. Is air entering the lungs? (Normal vesicular murmur.)
2. Is air entering both lungs equally?
   (Breath sounds of same intensity on both sides.)
3. Is air entering the whole lung?
   (Normal breath sounds everywhere.)

4. Has the normal consistency of the lung been anywhere altered?
   (a) Less elastic (emphysematous breathing).
   (b) Encroachment of solid parts on air cells (fibrosis—partial consolidation). (Bronchovesicular voice and breath sounds.)
   (c) Replacement of normal spongy tissue by solid—(consolidation).
5. Is the respiratory passage from alveoli to trachea free from obstruction—mucus, blood, pus, etc.? (Râles.)
6. Is the lung in contact with the chest wall or does something intervene, as fluid? (Muffling of sounds.)
7. Is the pleura smooth? (Friction rub.)

How to listen—

Listen to the breathing with the naked ear first, putting one finger in the other ear and using the sounding cloth. This method is especially important in examining the posterior aspect of the chest.

With the stethoscope listen to the whole chest—explore especially the axillae. Listen to first one side and then the other, always in the same order. Do this—

(a) With the patient breathing quietly.
(b) With the patient breathing more deeply.
(c) With the patient breathing in, then out, and immediately giving a quick short cough.
(d) While the patient counts "1, 2, 3."
(e) While the patient whispers "1, 2, 3."

Visualization of the Bronchial Tree—Ten per cent cocaine solution applied to palate, pharynx, and base

of the tongue. One per cent cocaine is dropped into the trachea through curved cannula. The tongue is pulled forward, and the patient is told to breathe naturally. Twenty c.c. of warm iodized oil is put into the trachea. This may be done through the bronchoscope, or by one of three other methods—subglottic, transglottic, or supraglottic. X-ray of the chest is taken at once. The whole bronchial tree should stand out clearly.

CHAPTER X

HEART

Object of Cardiac Examination

1. To determine—
    1. Position of heart.
    2. Shape of heart.
    3. Size of heart.
2. To determine quality of the myocardium.
3. To determine condition of the valves.
4. To determine state of the conductive system.
5. To determine the condition of the pericardium.

1. Position of the Heart—

This hollow, muscular, conical organ, lying in the lower part of the thorax, is bounded—

(a) Anteriorly by—
    1. Lungs.
    2. Pleurae.
    3. Thoracic wall.

This is a triangular area (area of absolute dullness)—

(b) Laterally by
    1. Lungs.
    2. Phrenic nerves.

(c) Posteriorly by
    1. Lungs.
    2. Esophagus.
    3. Thoracic aorta.
    4. Vena cava.

(d) Inferiorly by diaphragm (stomach).

The heart lies behind the 3rd, 4th, 5th costal cartilages and the lower two-thirds of the sternum.

It lies in front of the first four dorsal vertebrae. Two-thirds of the heart lies to the left of the midline, and one-third to the right.

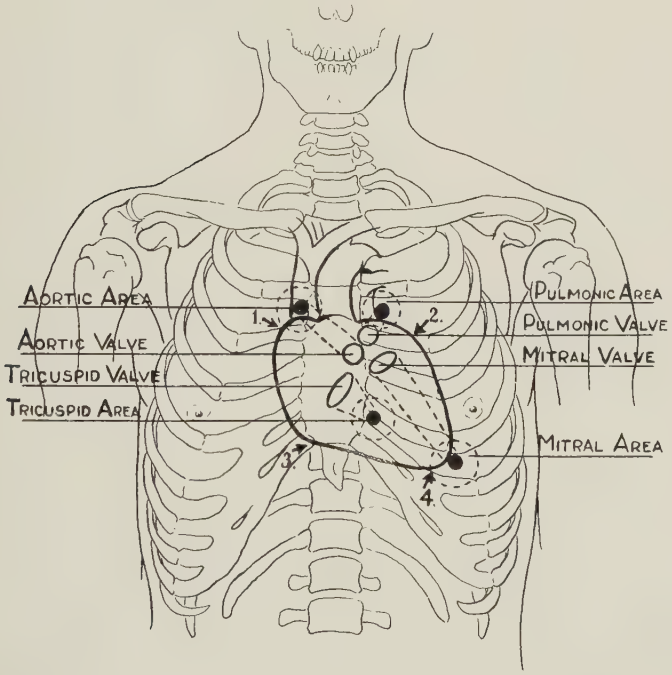

Fig. 29.—Showing the topography of the heart: valve areas, position of the valves, and the surface projection of the cardiac outline. *1, 2, 3, 4* represent the points necessary to be connected in plotting the outline.

Anterior Surface—

1. Right auricle.
2. Right ventricle.
3. Left ventricle.

The *Apex* is part of the left ventricle.

Topography of the Heart—(Piersol).

The position of the heart can be outlined on the anterior surface of the chest by connecting four known points:

1. Upper border of third costal cartilage, 3 cm. to the right of the midsternal line.
2. Just above third costal cartilage 4.5 cm. to the left of the midsternal line.
3. Seventh right costal cartilage and its juncture with the sternum.
4. Apex—fifth intercostal space 8 cm. to the left of the midsternal line. The lines connecting these points should be slightly convex outwardly, except the lower horizontal line.

Displacement of the heart from its normal position.

It may be pushed, or pulled, up, down, backward, forward, to right or to left.

Displacement in Health—

1. Posture of body (play is chiefly from side to side).
2. Distended stomach (lifting heart).
3. Situs inversus—dextrocardia.
4. Breathing. (Leaning forward useful in bringing larger part of heart in contact with chest wall and so increases accessibility for examination.)

Downward shift may be 1 inch.

Lateral shift may be 1-2 inches. (Sahli, page 232.)

2. **Shape of Heart—**

Inverted cone. Apex points down, to front and to left. Base looks backward, upward and to right.

Position is, therefore, oblique. The heart conforms in large measure to the body conformation. "Skinny body, skinny heart." The tall, slender individual shows a long slender heart, the so-called "dropped heart."

3. **Size of Heart—**

Weight—(Average adult)—

Male— 11 ounces

Female— 9¾ ounces

Measurements—(Average adult)—

Length (maximum)—4¾ to 6 inches.

Breadth (maximum)—3½ to 4¼ inches.

Thickness (maximum)—2 to 3¼ inches.

Examination Technic

The application of (1) Inspection, (2) Palpation, (3) Percussion, (4) Auscultation, (5) X-ray, (6) Electrocardiogram, (7) Sphygmogram to the examination of the heart.

Inspection—Most important. (A good diagnostician frequently recognizes heart disease across the room.)

What to look for—

I. *Evidence of cardiac size and position.*

(a) Position and nature of visible apex beat.

(b) Conformation of thorax.

(c) Cardiac heave (precardium).

(d) Abnormal impulses and retractions.

Apex Impulse—

1. Cause—right ventricle.

2. Position—

(Adult) 5 i. c. s. inside M. C. L.*
(Child) 4 i. c. s. inside M. C. L.
(Aged) 6 i. c. s. inside M. C. L.

3. Represents—point ¾ inch inside true apex.

Absence of apex impulse due to—

1. Thick chest wall.
2. Feeble heart.

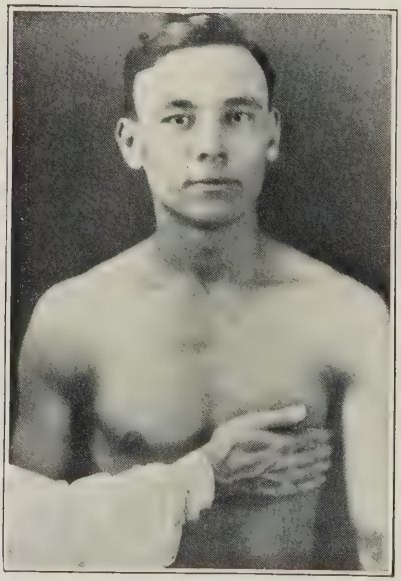

Fig. 30.—Palpation of the cardiac impulse (first step). (From Rose: *Physical Diagnosis.*)

II. *Evidence of cardiac rate and rhythm.*

Rate and rhythm of

1. Apex beat.
2. Visible vessel pulsations.

*M. C. L. = Midclavicular line.

III. *Evidence of effective cardiac output.*

(a) Color of mucous membranes and skin.
(b) Respiratory rate.
(c) Position of patient in bed, etc.

Palpation—I. *Apex beat.*

(Using palm of hand)—

1. Rate.
2. Rhythm.
3. Force of heartbeat.

(Using tip of finger.)

True apex. This corresponds to the point where the impulse stops and is ¾ inch to left of the visible beat.

II. *Thrill.*
III. *Pericardial friction.* } Found only in disease.

Percussion—

Used to determine cardiac outline.
Very difficult.
Light percussion essential.
Always approach heart on a line perpendicular to surface.
Use skin pencil to mark outline.
Mark out upper, right and left borders.

Superficial area of cardiac dullness.

Where heart is uncovered by lung and is, therefore, against chest wall.

Easy to outline.

Uncertain significance due to variableness of lung borders.

Area triangular in shape.

Made up thus—

1. Midline.
2. Horizontal line through apex.
3. Oblique line from apex to juncture of fourth rib and midline.

Base of this area merges into liver flatness.

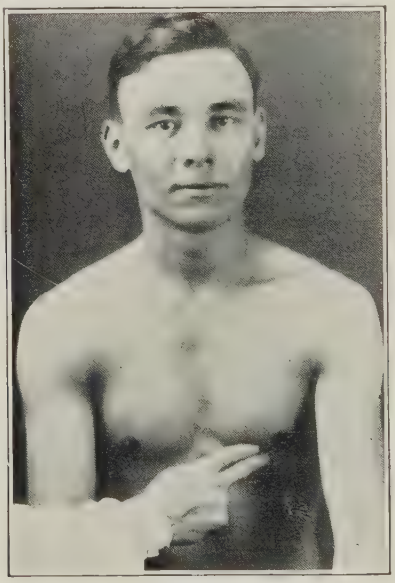

Fig. 31.—Palpation of the cardiac impulse (second step). (From Rose: *Physical Diagnosis.*)

Area of deep cardiac dullness—

True cardiac outline.

More difficult to determine.

Dullness due to overlapping of the lung.

Its outlines have been given under topography of the heart.

When outlining right border, note

1. Heavy or deep percussion necessary.
2. Percuss during expiration.
3. Error—1 cm. inside.

Difficulties of cardiac percussion due to—

1. Female breast.
2. Fat or muscular chests.
3. Varying degree of overlapping lung.
4. Deformity of chest (rickets).
5. Rigidity of thorax (age).
6. Geometrical causes.
   (a) Small children.
   (b) Enlarged hearts.
   (c) Round chests.

Auscultation of the Heart—

Before beginning the study of the cardiac sounds one must review carefully the physiology of the heart, especially of the heart valves and sounds.

Semilunar Valves—

Guard—

1. Systemic aorta.
2. Pulmonary aorta.

Each valve consists of three segments.

Each segment is a crescentic pouch-like structure with concavity away from heart.

Attached to fibrous ring of the orifice.

Auriculoventricular Valves—

1. Separate right auricle and right ventricle—tricuspid.
2. Separate left auricle and left ventricle—mitral. Mitral (bicuspid) consists of 2 cusps.

Tricuspid consists of 3 cusps.
Each cusp is attached to fibrous ring of valve.
Free edges are joined to papillary muscle by *chordae tendineae.*

Heart Sounds

The closure of the above valves is mainly responsible for the heart sounds. In snapping back, the cusps suddenly become tense. Vibrations are, therefore, set up in the cusp. These are transferred to the blood and in turn to the heart muscle and surrounding tissues. These vibrations when heard constitute the heart sounds.

The events of the cardiac cycle must always be kept in mind in auscultating the heart.

Sequence of Events in Each Cardiac Cycle

Sounds	*S. L. V.*	*A. V. V.*	*Ventricles*	*Auricles*	*Aorta*
1. S_2 (Beginning)	CLOSE	Closed	Relaxing (Closed)	Receiving blood	Closed
2. S_2 (Ending)	Closed	OPEN	Receiving blood	Discharging blood	Closed
3. S_3	Closed	Open	Receiving blood	SYSTOLE	Closed
4. —	Closed	Open	SYSTOLE	Receiving blood	
5. S_1	Closed	CLOSE	Systole (Closed)	Receiving blood	
6. S_1	OPEN	Closed	Systole (Closed)	Receiving blood	Receiving blood

If heart is beating 70 times a minute—

Duration of ventricular systole—.379 second.
Duration of ventricular diastole—.483 second.
Duration of auricular systole—.1—.17 second.
Duration of auricular diastole—.762—.692 second.
(Howell.)

Refractory period of heart (rest period) longer than period of activity (systole).

First sound of heart (S_1, systolic sound).

Composed of two elements—

I. High-pitched and valvular sound.

Cause—Tensing of A. V. valve cusps. (Mitral and tricuspid.)

Proof—Sound disappears when these cusps are prevented from closing as when

(a) Held back by a loop of wire.

(b) Sclerosed or destroyed by disease.

II. Low-pitched booming sound.

Cause—Contracting heart muscle.

Proof—Heard over a bloodless heart.

Second sound of heart (S_2, diastolic sound).

A high-pitched valvular sound.

Cause—Tensing of semilunar cusps in aortic recoil. (Pulmonary aorta and systemic aorta.)

Proof—Sound disappears if the closure of these cusps is prevented by a loop of wire or by disease.

Third sound of heart (S_3).

A soft low-pitched sound.

Cause—Tensing of A. V. valves with inrushing blood from auricles to ventricles.

Proof—See Thayer—Boston Medical Journal, 1908, clviii, 713.

Heart sounds are noises.

Murmurs and bruits are adventitious sounds caused by blood at great pressure escaping into blood of low pressure, producing whirls and eddies.

Analysis of Cardiac Sounds

	1st Sound	*2nd Sound*	*3rd Sound*
Duration	Longer	Shorter	Short
Intensity	Louder	Weaker	Still softer
Quality	Booming	Valvular	Thud or hum
Pitch	Lower	Higher	Still lower
Duration (Seconds)	0.05-0.15	0.015-0.056	Short
Time	Systolic	Diastolic	Diastolic
Location	Apex	Base	Apex
Cause	Closing A. V. V.	Closing S. L. V.	Blood flowing into ventricle
Radiation	Down and to left	Into neck	—

Third Heart Sound—

Heard in 65 per cent of adults.

Loudest at apex.

Brought out by left lateral recumbent posture.

Naked Ear—

Useful in cardiac examination.

It picks up low-pitched sounds which are less well heard through the stethoscope. (The murmur of aortic regurgitation is thus best studied.)

Valve Areas—

Are those points on the anterior surface of the thorax over which the different heart sounds are best heard. They do not correspond to the anatomic position of the valves. They are the mitral, tricuspid, aortic, and pulmonic.

	Surface Projection of Valves	*Where Tone Is Best Heard "Valve Area"*
Mitral	Juncture 3rd left costal cartilage and sternum	Apex
Tricuspid	Halfway between the above and 5th right costal cartilage and sternum	Lower sternum
Aortic	Level of 3 i.c.s. and through middle sternum	2 i.c.s right
Pulmonic	2 i.c.s left	2 i.c.s left

How are we to distinguish one valve sound from another in cardiac auscultation?

By—

1. The rhythm (accent)—at apex S_1 accentuated.
2. The pauses—S_1 follows long pause.
3. Palpating the cardiac apex—synchronous with S_1.
4. Palpating the carotid artery—synchronous with S_1.
5. Palpating the radial. (Erroneous.)

Rhythm—

Varies from apex to base.

At apex—Trochee — ⏜

Lupp-dupp_____ { mitral / tricuspid } emphasis.

At base—Iambic ⏜ —

Lupp-dupp_____ { aortic / pulmonic } emphasis.

(For discussion see Sahli, page 309.)

We cannot always depend on rhythm to differentiate S_1 from S_2. There may be no distinguishing accent. There are many disease rhythms.

Pauses—

There are two pauses in each cardiac cycle as there are two sounds. These are the

(a) *Long pause.*
(b) *Short pause.*

The long pause usually precedes the systolic sound, S_1. This pause relation does not always hold, however. "Pendulum rhythm," for example, is characterized by pauses of equal duration. Pendulum rhythm = fetal rhythm. (Embryocardia.)

The surest way of knowing which is the first sound is to relate it to the systole of the heart as felt. While listening to the heart, palpate apex, carotid artery, or maybe the radial artery.

Palpation of the Apex—

Good if it can be done.

Interfered with by—

1. Thick chest wall.
2. Feeble beat.
3. Tachycardia.
4. Pathologic conditions.

Palpation of Carotid Artery—

Should be the routine procedure.

Rapidity of pulse may interfere.

Palpation of Radial—

Mentioned only to condemn.

Maximum wave as often agrees with diastole as with systole.

May be used in *very slow* hearts.

Cardiac Murmurs—

Must properly be related to cardiac sounds for proper interpretation. They may follow, precede, or replace either the first or second sound. It is, therefore, most important to master the methods for determining which is the first and which the second sound.

Factors affecting loudness of heart sounds.

Decreased by—

(a) Body wall { Fat. / Muscle. / Female breasts.

(b) Pushing heart from chest wall. (Fluid, air, etc.)

(c) Decreased force of heartbeat.

Increased by—

(a) Thin chest wall.

(b) Shrinkage of overlying lung or pushing of heart to surface.

(c) Resonance from air-filled stomach.

(d) Increased sound conductivity of surrounding tissue. (Pneumonia.)

(e) Increased force of heartbeat. (Examine following exercise.)

Alteration in the timbre (quality) of heart sounds.

Not much stress can be laid on this.

One speaks of the poor or the good quality of heart sounds, but the distinction has doubtful meaning.

Effect of age on heart sounds.

(The variation occurs at the base.)

	P_2	A_2
Youth	Accentuated	Less than P_2
Middle Age	Equal A_2	Equal P_2
Old Age	Less than A_2	Accentuated

In estimating the effect of disease in accentuating one or the other of these two valve sounds normal age variation must be always in mind.

Why is mitral valvular sound heard at the apex?

Left ventricle (in which the sound is produced) is uncovered by the lung and right ventricle at the apex, which is not the case just over the valve.

Technic of Cardiac Auscultation.

Same as that used in pulmonary examinations.

Auscultation should be performed with patient

1. Lying.
   (a) Dorsal decubitus.
   (b) On side.
2. Sitting.
3. Standing.
4. After exercise.
   (This should be done in conjunction with the blood-pressure determination.)
   (a) Immediately. The normal heart is accelerated. The systolic blood pressure is lowered and the diastolic raised.
   (b) After 30 seconds. Heart rate 110, systolic pressure raised (25 points), diastolic lowered (5 points).
   (c) After 2 minutes. Heart rate and blood pressure return to normal.

Auscultatory Information about the Myocardium

This is scant and not very reliable.

1. *Rate*—A normal myocardium contracts at a normal rate. A weakened muscle to accomplish its work has to contract more rapidly.
2. *Rhythm*—This should be regular. A diseased muscle frequently contracts irregularly.

3. *Character of the first sound*—Normally this is a compound of the low-pitched booming muscle note and the high-pitched valvular tone. Alterations due to disease may
   1. Increase the muscle sound to a powerful booming, or
   2. This element may be "muffled" and the valvular element predominate if the muscle is weak.
4. *The response of the myocardium to exercise*—
   (Patient hops on one foot 100 times.)
   Normal response—
   1. Increased rate of heartbeat—raised 40 beats a minute.
   2. Quick return to normal—accomplished in two minutes.

State of the Conductive System

The wave of cardiac contraction starts in the sino-auricular node, "pacemaker" ("Imbedded in the right *auricle* near the mouth of the superior vena cava"); spreads through the walls of both auricles; and then through the bundle of His to the ventricles.

The pacemaker sends out about 72 beats a minute. The vagus controls the pacemaker. If the human vagi were cut, the rate would probably rise to 150-160 per minute.

Normal constant slowing of the pulse—(vagus inhibition).

Athletes, pregnancy (rate 50-60).

A few normal individuals constantly show a pulse around 50.

Normal periodic slowing of the pulse—(vagus inhibition).

1. Children (during normal respiration).
2. Puberty (during normal respiration).
3. Young adults (during forced breathing).

Nature of the irregularity—

Inspiration—pulse quickens.
Expiration—pulse slows.
This is known as sinus arrhythmia.

The stethoscope affords excellent information about the conductive system of the heart. If the rate and rhythm of the heart are normal, this system is apt to be normal. It is true that early heart-block might be missed. Disease of the system manifests itself in irregularities of various types with alterations in the natural pauses of the heart.

The electrocardiogram affords exact information concerning the conductive system. The methods of physical examination already outlined are sufficient, however, in the vast majority of cardiac conditions to arrive at a satisfactory diagnosis.*

The polygram likewise affords information of value. It is more difficult to make and to interpret.

X-Ray of the Normal Heart

Data obtainable by x-ray—

1. Size of the heart and aorta.
2. Shape of the heart and aorta.
3. Movements during respiration.
4. Pulsations of various chambers.
   (Except the right ventricle.)
5. Effects of position.

*Sir James Mackenzie once said, "I have nearly abolished all instruments from my own practice."

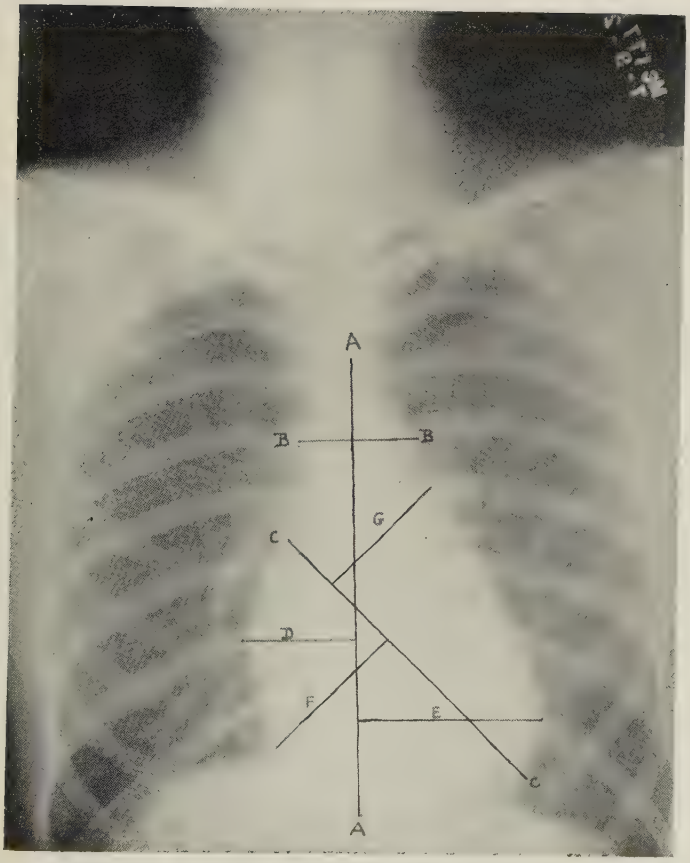

Fig. 32.---Skiagraph of the heart. *BB*, width of the aortic arch; *CC*, length of the heart; *D* plus *E*, transverse diameter of the heart.

Methods

1. **Fluoroscope—**

(This of itself affords fairly accurate information.)

Technic—

(a) Patient stands behind screen.
(b) Focal spot at 24 inches from screen.
(c) Thin glass plate, or very thin paper held against screen on which to outline in pencil heart and vessels.
1. During normal breathing.
2. During forced inspiration.
3. During forced expiration.
(d) Rotate patient to left with right chest against screen. Study posterior mediastinum and arch of aorta in this position. (Smallest shadow represents true diameter of aorta [with deductions for distortion].) By using only central rays an orthodiagram can be made with the fluoroscope.

The cardiothoracic ratio is the usual way of expressing heart measurements. The longest diameter of the heart and the thoracic diameter at the level of the heart are compared. The longest diameter of the heart should not exceed one-half the thoracic diameter.

2. **Plates—**

Afford a permanent record.
Allow of accurate measurements.
Take at distance of 6 feet.

Normal cardiac shadow on plate shows following convexities—

(a) On the right—
1. Above—ascending aorta.
2. Below—right auricle.

(b) On the left—

1. At top—arch of aorta.
2. Below—pulmonary aorta.
3. Below—left auricle.
4. Bottom—left ventricle.

Normal cardiac measurements on plate—

6 points taken, 3 on right and 3 on left.

Points on right (from above down).

1. Juncture of heart and great vessels.
2. Widest point.
3. Juncture of heart shadow and diaphragm.

Points on left (from above down).

4. Juncture of left auricle and left ventricle.
5. Widest point.
6. Apex.

Lines—

1. Midperpendicular line.
2. Horizontals to midperpendicular from points 2 and 5.
   Right horizontal (3.3 cm.).
   Left horizontal (6.8 cm.).
3. Greatest transverse diameter is the sum of the above two.
   (3.3 cm. + 6.8 cm. = 10.1 cm.)
4. Length of heart—from highest point of right to apex (14 cm.).
5. Perpendiculars to the line of the length of the heart at the lowest point on the right and the highest point on the left. The sum of the two equals the width of the cardiac base. (6.2 [right] + 4.5 [left] = 10.7 cm.)

Hirsh has criticized the so-called "standard methods" of x-ray examination. He shows that habitus determines the position, form, and size of the heart.

Habitus	*Position of Heart*	*Form of Heart*
1. Asthenic	Vertical	Long and narrow
2. Hyposthenic	Very oblique	Circular
3. Sthenic	Oblique	Triangular
4. Hypersthenic	Transverse	Oval

(1) *a* = negative. *σθένος* = strength.
(2) *ὑπο* = under. *σθένος* = strength.
(3) — *σθένος* = strength.
(4) *ὑπερ* = over. *σθένος* = strength.

Pericardium

There are no signs in health, and the description is purely negative.

Inspection—

Apex beat seen in normal position.

No abnormal impulses or retractions.

Palpation—

Apex felt in normal position.

Percussion—

Cardiac outline normal.

Auscultation—

Normal valvular sounds.

No friction rub.

X-ray—

Normal cardiac shadow.

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CHAPTER XI

BLOOD VESSELS

The vascular system outside the heart includes

1. The aorta.
2. The arteries.
3. The veins.
4. The capillaries.

All of these divisions are accessible to examination.

The Aorta

1. **Arch—**
   - (a) Ascending portion.
   - (b) Transverse portion.
   - (c) Descending portion.
2. Thoracic aorta.
3. Abdominal aorta.

Anatomy and Relations of the Arch

(About one inch in diameter.)

(a) **Ascending Portion—**

Two inches long. Almost entirely in visceral pericardium.

Extends from inner end of third left costal cartilage obliquely up to upper border of second right costal cartilage behind sternum.

(b) **Transverse Portion—**

1. Upper border = 1 inch below sternal notch. Middle 1st costal cartilage. Middle of manubrium. 3rd thoracic spinous process.
2. Lower border = Juncture manubrium and

gladiolus. In relation to left phrenic, cardiac, pneumogastric, and left recurrent laryngeal nerves, trachea, esophagus, superior cava, and left bronchus.

(c) **Descending Portion**—Little to left of fourth thoracic vertebra.

Examination of the Aortic Arch

Inspection—

(a) In health nothing can be seen.

(b) In disease (aneurysms), most valuable information can be obtained.

(It is good exercise to figure out the effects of a large pulsating mass in the region of the aorta—all the structures pressed upon—what may be seen, felt, heard.)

Palpation—Nothing felt in health.

Percussion—

Difficult. (Behind sternum.)

Dimensions of the shadow (x-ray)—2 inches × 3 inches.

Descriptions are negative. Thus, in health we say "there is no widening of the arch on percussion."

One should not be able to percuss the aorta outside the sternal borders.

Auscultation—The aorta is silent in health.

X-ray and Fluoroscope—

Gives valuable information about the size and shape of the aortic arch.

Width of maximum aortic shadow—4.5 cm.

Width of shadow increased in brevilinear persons and decreased in longilinear.

Arteries

A normal artery has a certain size, course, and compressibility. Its wall is soft and elastic. The blood has a normal tension. All these characteristics may change in disease.

The *ordinary examination* of an artery is an examination of the *pulse.*

Vessel Wall—The arteries of the temple can often be seen. Occasionally arteries in the arm can be seen. This occurs chiefly, however, in the aged.

The visual inspection of arteries can be well carried out in the oculi fundi. Ophthalmoscopic examination is of more value than feeling the pulse. The eyegrounds are the only places in the body where one sees arteries face to face, as it were. Here we can see whether walls are thickened, calcified, tortuous, broken, etc.

Palpation—Temporal, radial, brachial, popliteal, tibial vessels should all be examined.

Vessels should be rolled under finger to feel for thickening, hardening, calcification.

Vessels may be absent or occupy abnormal positions.

Auscultation of Arteries—

1. Small arteries toneless.
2. Pressure over any artery with the stethoscope will usually bring out a loud systolic murmur.
3. Normally over the carotid and subclavian there occur two sounds.
   (a) Systolic tone (tension in vessel wall).
   (b) Diastolic (transmitted from aortic valves).

Over abdominal aorta
Over femoral artery } occasionally a systolic tone.

Pulse—

Still important in physical examination.

Teaches—

1. Condition of arteries.
2. Function of heart.

Technic—

1. Three fingers { Middle one to feel with. / Distal two shutting off blood.
2. Function of heart.

Fig. 33.—Palpating both radial pulses. (From Rose: *Physical Diagnosis.*)

3. Radial arteries used. (Temporal, carotid or tibial may be used.)
4. Always palpate both radials at once.
5. Roll artery under finger.

What to feel for—

1. *Condition of vessel wall.*

Normal vessel—

(a) Straight (tortuous in arteriosclerosis),

(b) Soft (hard in arteriosclerosis).
(c) Smooth (beaded in arteriosclerosis).
(d) Elastic (stiff in arteriosclerosis).
(e) Thin (thick in arteriosclerosis).

(To elicit this information run finger along vessel as well as roll it under finger.)

While compressing vessel above, palpate it distally. A normal vessel wall should not then be felt.

Tortuous temporal vessel normal.—(Cabot.)

2. *Position of vessel.*

(a) May be absent.
(b) May be out of its normal relations. (Aberrant.)
(c) May be covered.

3. *Size of vessel.*

Some vessels abnormally small.

(The following points afford information about cardiac action.)

4. *Frequency* (rate).

(Count for one minute and repeat in rapid or irregular hearts—rate heard at the apex always more reliable.)

Varies with—

(a) Excitement.
(b) Exercise.
(c) Going to stool.
(d) Posture.
(e) Eating.
(f) Breathing (increased with inspiration).
(g) Sex (female faster).

(h) Age.

Fetus	144	to 133	
To 1st year	143	to 123	
10 to 15 years	91	to 76	
20 to 60 years	73	to 69	(Roelet)

Tachycardia—rapid pulse.

Bradycardia—slow pulse.

May be congenital as a rate of 50 to 60—vagus inhibition.

5. *Equality.*

Inequality—

(a) Difference in size of arteries.
(b) Pressure on one vessel.

6. *Rhythm.*

Normal rhythm is regular with equal spacing between beats.

Types of irregular rhythm—

(a) Respiratory or sinus arrhythmia (children).
(b) Complete irregularity (fibrillation).
(c) Extrasystoles (old age).
(d) Intermittent pulse—drop beat. (Block.)
(e) Alternating pulse (small and large).

7. *Size of pulse wave.*

8. *Celerity.*

Rapidity of rise and fall of wave under finger.
(a) Pulsus celer—a sharp rap.
(b) Pulsus tardus—slow wave.

9. *Compressibility.*

Indicates tension. (See Blood Pressure.)
(A dicrotic pulse has a notch in the down stroke.)

Veins

Certain cardiac phenomena are portrayed in venous engorgement and pulsations.

Disease of the vein itself, of course, occurs.

Veins to be Examined—

1. Cervical (Jugular).
2. Legs (Varicose).
3. Abdomen (Anastomosis).
4. Scrotal (Varicocele).
5. Oculi fundi (Optic veins—cerebral pressure).

Distended Veins—

Causes—

1. Inspiration.
2. Coughing.
3. Obstruction ahead.
   (a) Back pressure from heart.
   (b) Mechanical.
4. Congenital.

Venous Pulse—

Impulse initiated in right auricle.

There is normally a jugular wave, though this cannot always be seen. (See Graphic Methods.)

Jugular Pulse—

1. Normal.
2. Presystolic.
3. A sharp rise followed by first a sharp fall and then a gradual fall in which there is a slight secondary rise, characterizes the curve.

First rise due to auricular contraction.

Second rise due to auricular filling.

Best made out in recumbency.

To distinguish venous from arterial pulse—

Press on vein to obliterate a true venous wave.

If coming through from an artery, it may be intensified.

In disease—

Presystolic jugular wave becomes systolic due to

1. Fibrillation.
2. Tricuspid regurgitation.

Pulsating livers are abnormal.

Auscultation of Veins—

In health usually silent.

In anemia there may occur a "venous hum."

Venous Blood Pressure—

A. Pressure exists in veins (bleed when cut).

B. Cause of venous blood pressure:

1. Force of heartbeat and other factors mobilizing blood and delivering it through the capillaries.
2. Central resistance—chiefly in the right auricle.
3. Tone of venous wall.

C. Venous blood pressure does not vary with capillary pressure.

Normal Venous Blood Pressure—

Upper limit of man at rest in bed 11 cm. of water. (Varies from 5-11 cm. of water.)

Causes of Variation in Health—

1. Age—increases.
2. Exercise—increases.
3. Time of day—decreases at night.

Method of Determining—

1. A glass box open on one side and having a connection for a rubber tube is secured to the surface of the hand over a vein with collodion.
2. The rubber tube is connected by a "Y" tube with a water manometer and a rubber bulb.
3. The hand is held at the heart level (midline, lower end of sternum).
4. Air pressure forced into apparatus by bulb until vein is obliterated.
5. Reading made on manometer.

A rough method has been known since 1902 (Gaertner). The fullness of the dorsal veins of the hands normally disappears as the hands are elevated above the heart level. Normally this obliteration occurs at about four inches above the heart level. In decompensated hearts (with venous back pressure) greater heights are reached before disappearance of the veins.

Use of the Method—

Useful in the study of decompensated hearts.

Capillaries

An enormous network of thin endothelial vessels .008 to .020 mm. in diameter, capable of holding all the blood in the body. They are probably under nerve control, which causes them to dilate independently of arterioles. In their study we may eventually find a cause for high blood pressure.

Normally—no pulsation.

In disease—

1. Hyperemia = capillary pulse.
2. Pulsus celer (aortic regurgitation) = capillary pulse.

To demonstrate—Use

(a) Finger nail pressed down.
(b) Glass slide on lips.
(c) Redness of forehead produced by firm pencil stroke.

Capillary Blood Pressure—

Normal—22.2 mm. of mercury.

Varied by—

1. Posture.
2. Intrathoracic pressure.
3. Local temperature.

Not affected by time of the day.

Method of Determining—The streaming of the erythrocytes may be seen at the base of the nail of the finger or the toe and the capillaries outlined under the microscope. Pressure may be applied over these capillaries sufficient to obliterate them. An instrument call a tonometer is used to exert this pressure on the capillaries. The effect is observed through a window on the top. The chamber of the tonometer is connected with a mercury manometer and a rubber bulb. Pressure is gradually applied over the capillaries at the root of the nail and the effect is observed under the microscope through the tonometer. The hand must be approximately at the level of the heart when the reading is made.

Capillary pressure probably varies with the force of the heartbeat and is independent, to a large degree, of venous pressure.

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CHAPTER XII

BLOOD PRESSURE

The pressure of the blood in the arterial tree is important. Increase or decrease is indicative often of serious disease. Information afforded by the sphygmomanometer is most valuable.

Hypertension is a term describing an arterial tension above the normal.

Hypotension, on the contrary, is used of pressure below the normal.

Systolic blood pressure is that pressure in the arteries at the moment of the heart's systole. It is the maximum pressure.

Diastolic blood pressure is that pressure existing during cardiac diastole. It is the minimum pressure.

Pulse pressure is a term applied to the difference between systolic and diastolic pressure.

Mean tension represents the arithmetical mean of the systolic and diastolic pressures. Thus S. P. = 120. D. P. = 80. M. T. = ½ (120 – 80) + 80 or 100.

Methods of Taking Blood Pressure—The old method of estimating arterial tension with the fingers is valueless and has been entirely replaced by the sphygmomanometer. This may be used in conjunction with—

1. Palpation.
2. The stethoscope.

Instruments—

1. *Mercury.* This is a mercury manometer to which is attached, by a rubber tube, a rubber bag surrounded by a cloth cover which in use is snugly wrapped about the arm above the el-

bow. A rubber bulb is also attached to the instrument to inflate the bag. The inflated bag exerts pressure over the brachial artery which is measured directly on the manometer.

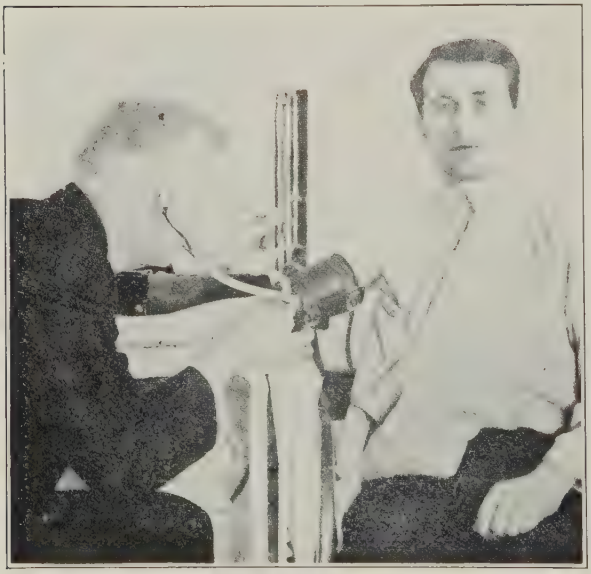

Fig. 34.—Taking the blood pressure with a mercury instrument. (From Rose: *Physical Diagnisis.*)

2. *Aneroid.* This is a spring instrument substituted for the mercury manometer. In other respects the instruments are alike. The spring instrument is, of course, standardized by the mercury manometer.

Technic of Use—

1. Apply band to arm.
2. Attach rubber tubes to instrument.
3. Inflate until by palpation the radial artery is obliterated.

Systolic Pressure—

4. Release pressure.
5. (a) Pulse just felt.
   (b) Read instrument, or
5. (a) Snapping sound heard through stethoscope over anticubital fossa.
   (b) Read instrument.

Diastolic Pressure—

6. (a) Continue to release pressure.
   (b) Oscillations become maximal.
   (c) Read instrument, or
6. (b) Sounds change from snapping to dull.
   (c) Read instrument.

Phases Which May be Heard by Auscultatory Method—

1. Loud, clear, snapping tone (covers 14 mm.).
   Advent of S. P.
2. Murmurs (covers 20 mm.).
3. Snapping tone again (covers 5 mm.).
4. Dull tone (covers 6 mm.).
   Advent of D. P.
5. Sounds stop.

Patient should be—

1. Comfortable.
2. Sitting or lying.

Reading should be done—

1. Quickly.
2. Should be read while column of mercury is coming down.
3. Should be repeated several times.

Normal Blood Pressure—

S. P. 110-135. D. P. 60-90. (Cabot.)
Great normal variation.

Factors Causing Variation—

1. Age. Usually increased with age. After 20 years of age add to 120, one-half of the years above 20.
   Thus 50 years, 50 − 20 = 30. ½ × 30 = 15 + 120 = 135.
2. Sex. 10 mm. lower in females.
3. Exercise. Rises 10 to 20 mm.
4. Sleep.
   1. *During.*—There is an average drop of 25 mm.
   2. *After*—
      (a) Morning—low.
      (b) Evening—high.
5. Time of Day. Rises in evening.
6. Food. Rises 10 to 15 mm.
7. Drink. Rises.
8. Smoking. Rises 5-25 mm.
9. Excitement. Rises.
10. Posture.

	Erect.		*Horizontal.*		*Erect.*
S. P.	+	→	+	→	−
D. P.	+	→	−	→	+
P. P.	+	→	+	→	−

(Faught.)

Systolic Blood Pressure—

A measure of the pressure exerted in the arterial tree during systole.

Varies greatly.

Decreases from the aorta to the periphery.

Diastolic Blood Pressure—

Thought by many to be more important.

Represents peripheral resistance or the load the arteries and aortic valves constantly bear.

More constant level. (Less subject to excitement.)
Fall less rapid as we go from aorta to periphery.

Pulse Pressure—

Measures the pumping effort of the heart.
Measures the heart load (the force of each systole).

Normal Relations—

S. P. : D. P. = 3 : 2.
P. P. : S. P. = 1 : 3.

Important Formulae

P. P. × P. R. = Velocity.
S. P. × P. R. = Work.

References

1. Faught, F. A.: Blood Pressure Primer.
2. Addis, T.: Blood Pressure and Pulse Rate Levels, Arch. Int. Med., 1922, xxix, 539.

CHAPTER XIII

SPHYGMOGRAPHY AND ELECTROCARDIOGRAPHY

The graphic representation of the pulse wave.

Polygraphy (Mackenzie) is a simultaneous representation of the arterial and venous waves.

Instruments—One or more levers write upon suitable moving paper. The levers are connected directly

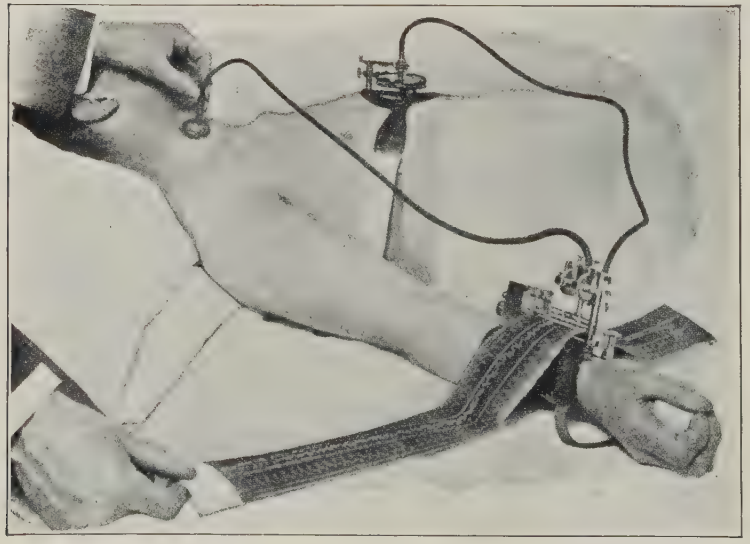

Fig. 35.—Sphygmocardiograph, Jaquet. (From Rose: *Physical Diagnosis.*)

with the surface over the pulsating vessels, or they are attached to diaphragms, connected with flexible tubes, the air of which conveys the pulsation from the surface over which their free end is attached.

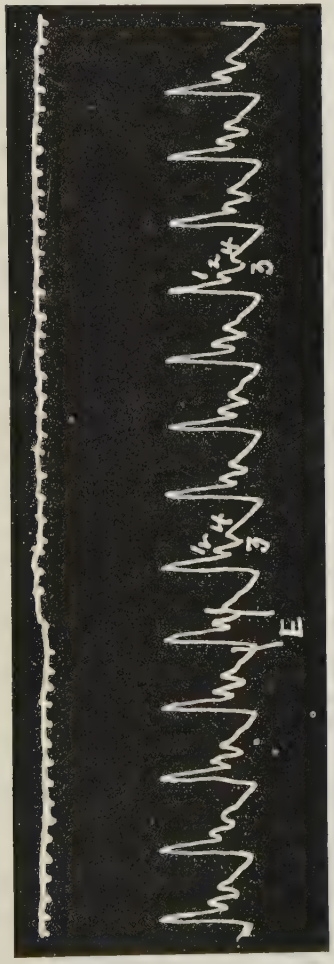

Fig. 36.—Arterial tracing. *1*, predicrotic notch; *2*, tidal wave; *3*, dicrotic notch; *4*, dicrotic wave. (From Rose: *Physical Diagnosis*.)

Normal Arterial (Radial) Curve—

1. Ascending limb to crest.
   (a) Amplitude (varies)—should not be too long or too short. Indicates volume of pulse.
   (b) Direction—normally almost perpendicular.
   Sharpness increased with quickness.
   (c) Summit—angular.
2. Descending limb.
   Gradual and undulating with 2 notches and 2 waves.
   (a) Tidal wave. Varies with arterial tension. Increased when high.
   (b) Dicrotic wave. Increases with fall in blood pressure.

Normal Venous Curve—Three positive and three negative waves.

Use of—Enables us to see and count beats of auricles as arterial curve does of the ventricle. Important in the study of cardiac arrhythmias.

Positive Waves

1. A wave. A contraction of auricle. (Immediately precedes the ventricular wave on the simultaneous arterial tracing.)
2. C wave. Protrusion of A. V. valves into auricles just before ventricular systole.
3. V wave. Ventricular due to checking of flow into auricle by A. V. closure.

Negative Waves

1. Due to auricular relaxation.
2. Due to "forcible dilatation of the auricle caused by the systole of the ventricle."
3. Due to blood being discharged into ventricle.

Electrocardiograms

Principle—Heart muscle, as skeletal muscle, during contraction sets up electrical waves. Electrodes attached to the surface of the body lead off these electrical changes to a string galvanometer. The movements of the string are photographed and constitute electrocardiographic tracings.

Apparatus—

1. Photographic camera.
2. String galvanometer.
3. Arc lamp.
4. Time recorder.
5. Central board.
6. Electrodes.
7. Table.

Leads—

Lead I. Right arm and left arm.
Lead II. Right arm and left leg.
Lead III. Left arm and left leg.

The Tracing—Three waves above the line and two below.

(a) Above—

1. P which is small.
2. R which is large.
3. T which is small.

(b) Below—

1. Q which is small.
2. S which is small.

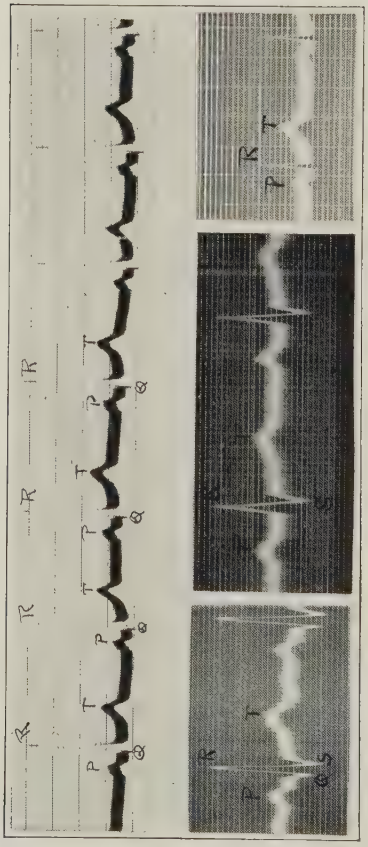

Fig. 37.—Specimens of normal electrocardiograms. (From Rose: *Physical Diagnosis.*)

Interpretation of Electrocardiogram

1. P-wave occurs just before auricular contraction.
2. Q-wave occurs just before beginning of ventricular systole.

3. R-wave (upstroke) occurs before ventricular systole.
4. T-wave occurs at the moment ventricle begins to relax.

Spread of Excitation Wave in Ventricles—

1. Downward over septum to apex (both sides).
2. Upward on endothelium of outer wall (both sides) to base.
3. At right angles to endothelium through muscle wall to pericardium. (This latter is slow.)

The Q. R. S. complex is a composite picture. It is the algebraic sum of effects in both ventricles. "The Q-wave is produced during the spread of the excitation wave in the septum and is a left-sided effect in Lead I and a right-sided effect in Leads II and III.

"The beginning of the R-wave is produced by the spread of the excitation wave in both ventricles. The remainder of the R-wave is a left-sided effect in Lead I and a right-sided effect in Leads II and III.

"The S-wave is a right-sided effect in Lead I and a left-sided effect in the other leads."

Period between S and T is one of entire cardiac excitement, or potential balance.

T-wave is due to electrical change consequent upon retreat of excitation wave. This is slow with absorption of deflections. Depends on the fact that the base remains excited longer than the apex.

Use of the Method—

1. Study of cardiac arrhythmias.
2. Study of cardiac conductive system.
3. Study of ventricular hypertrophy.

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2. Macleod, J. J.: Physiology and Biochemistry in Modern Medicine, St. Louis, 1929, C. V. Mosby Co.

CHAPTER XIV

ESOPHAGUS AND ABDOMEN

ESOPHAGUS

Begins 5 to 6 inches from incisor teeth.
Ends 14 to 16 inches from incisor teeth.
Length 9 to 10 inches.

Normal Constrictions—

1. Level of cricoid cartilage.
2. Level of aorta.
3. Level of left bronchus.
4. Level of diaphragm.

Examination—

(Because behind trachea and partly intrathoracic, difficult to examine.)

1. *Auscultation—*
   Fluid normally passes in 4 seconds.
   Listen with the stethoscope for first and second sounds, and time over cardiac end of stomach.
2. *Sounds and Bougies—*
   Flexible and blunt pointed.
   Less used than formerly—dangerous.

Technic—

Grease and warm instrument.
Patient sits with head back and mouth open.
Depress tongue while patient swallows and breathes regularly.
Observe gentleness.

Use—To determine whether or not lumen is free.

3. *Esophagoscope*—(Most valuable)—
   Pass with patient on right side, head back.
   Cervical esophagus closed.
   Thoracic esophagus open.
   Inspect surface for masses, ulcers, constrictions, pulsations, diverticula, and foreign bodies.
4. *X-ray*—
   Barium sulphate, with or without mucilage of acacia.
   Examine in right oblique diameter.
   Outline seen throughout—smooth.
   Depressions behind arch of aorta and behind heart.
   The opaque mass pauses for a moment at the arch and cardia.

ABDOMEN

Anatomy—

Boundaries—

External—

1. Costal arch and subcostal angle.
2. Pubic crest.
3. Folds of the groin.

Internal—

1. Diaphragm.
2. Pelvic outlet.

Contents—

1. Liver, spleen, stomach—upper zone.
2. Right kidney, cecum, ascending colon—right lateral recess.
3. Left kidney, descending colon—left lateral recess.

4. Intestines, pancreas—middle space.
5. Great vessels, omentum, mesentery, lymph vessels and glands.

Abdominal Landmarks

1. Scrobiculus cordis (pit of stomach).
   (Between 7th costal cartilages.)
2. Costal arch.
   (From apex of costal angle to 10th costal cartilage.)
3. Symphysis pubis.
4. Anterior iliac spines.
5. Pubic spines.
6. Umbilicus (navel).
   (4th lumbar vertebra and iliac crest.)
7. Linea alba.
8. Lineae transversae.
9. Lineae semilunares (outer borders of recti).
10. Cutaneous flexion folds—2—(in fat people—1st on level of umbilicus, 2nd 1 inch above pubis).
11. Flanks.
    (Lateral—thorax to ilium.)
12. Sacral triangle—(depression over sacrum).
13. Loin—(12th rib to ilium).

Ideal Shape—"Ovoid, bulged centrally, flattened anteroposteriorly, longest diameter vertical."

Contour—Gentle convexity exaggerated at the flanks.

Variations in health due to

1. Age.
2. Sex.
3. Fat.
4. Corsets.
5. Pregnancy.
6. Sedentary life.
7. Muscular development.

Circumference of the Abdomen

(Measured at level of umbilicus.)

Sex	*Age*	*Compared to thoracic circumference at nipple*
Male	Under 40	2 to 4 inches less
Male	40	Equal
Male	50	Larger
Female	—	10 inches less
Children	—	Larger (due to liver)

Methods of Examining Abdomen

Inspection, palpation, percussion, auscultation, x-ray, mensuration, tube, needle.

All methods crude. Chief help from palpation.

Equipment—Table, 3 feet high, 2 feet wide. Comfortable cushion; small pillow; sheet; good light.

Inspection—

Light—tangential (accentuates shadows of uneven surfaces).

1. Dorsal decubitus.
2. Standing (light from side). (Best way to bring out ptosis.)

What to look for—

1. Configuration (contour of abdomen).
2. Surface (skin and umbilicus).
3. Size.
4. Respiratory movements (limitation—absence) (male or female type).
5. Peristalsis (gastric—intestinal) (thin subjects).
6. Local depressions.
7. Local prominences.

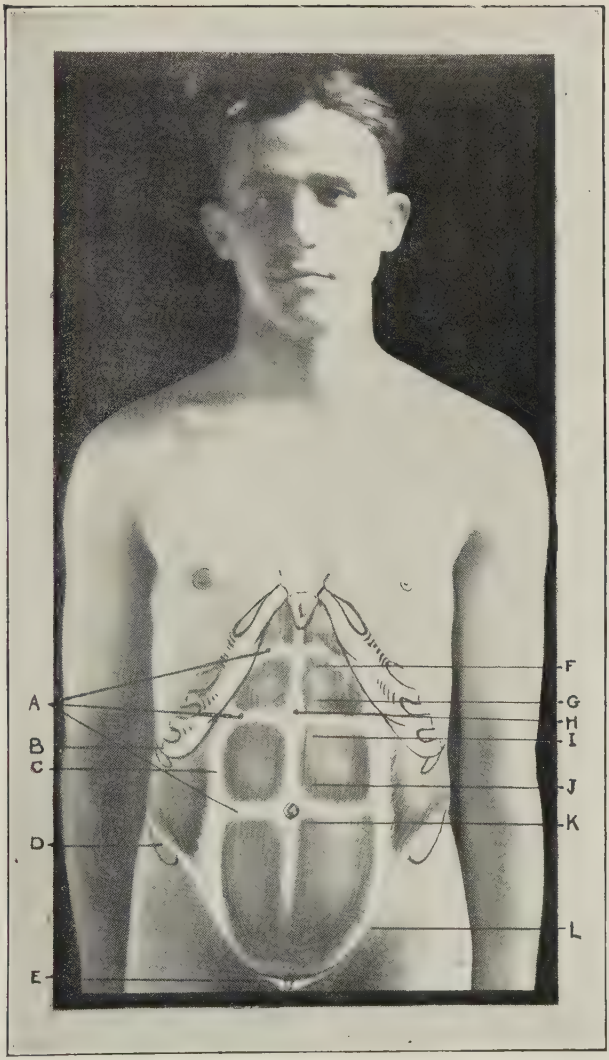

Fig. 38.—Anatomic landmarks of the abdomen. *A*, lineae transversae; *B*, costal arch; *C*, linea semilunaris; *D*, anterior superior iliac spine; *E*, symphysis pubis; *F*, commencement of abdominal aorta; *G*, origin of celiac axis; *H*, linea alba; *I*, origin of superior mesenteric artery; *J*, origin of inferior mesenteric artery; *K*, bifurcation of aorta; *L*, Poupart's ligament. (From Rose: *Physical Diagnosis.*)

Palpation—(Most valuable method.)

Technic—

1. Both physician and patient comfortable.
2. Warm hands and warm room.
3. Posture symmetric.
   Proceed cautiously and gently (to avoid injury).
4. No sudden movement (to frighten patient).

Fig. 39.—Palpating the abdomen. (From Rose: *Physical Diagnosis.*)

5. Postures—
   (a) Dorsal decubitus.
   (b) Right and left lateral.
   (c) Knee-chest.
   (d) Erect.

(e) Trendelenburg (on back, hips 45° higher than head).
(f) Elevated pubic posture.

6. Head on pillow. (Knees up.)
7. Breathing deeply with mouth open.
8. With palm of whole hand go over whole abdomen, using light pressure.
   (Avoid finger nails and finger tips.)
9. With one hand pressing on the other, exert firm pressure during one or two expiratory movements.
   (Hand that is not pressing more sensitive.)
10. Feeling for tenderness, examining suspected tender points last.

To get relaxation—

1. Divert attention.
2. Breathing with mouth open.
3. Warm bath (long tub, water 110°-120° for 10 minutes).
4. Anesthesia (especially pelvic examination).
   Talcum powder on abdomen may facilitate examination.
   Raise hips on pillow to palpate lower abdomen.
   Water enema to remove gas that interferes.

What can be felt in normal abdomen—(Cabot.)

1. Abdominal aorta.
2. Spinal column (near umbilicus).
3. Liver (in the thin with short angle).
4. Lower pole right kidney (young).
5. Gurgling and splashing.
6. Iliopsoas muscle (thin patients).

7. Muscle bundles in external oblique (cf. appendix).
8. Head of pancreas.
   (If thin patient—Leube.)

What to feel for—

1. Resistance of belly (wall and contents).
2. Boundaries of organs.
3. Sensitiveness to pressure.
   (a) Gentle pressure.
   (b) Firm pressure.

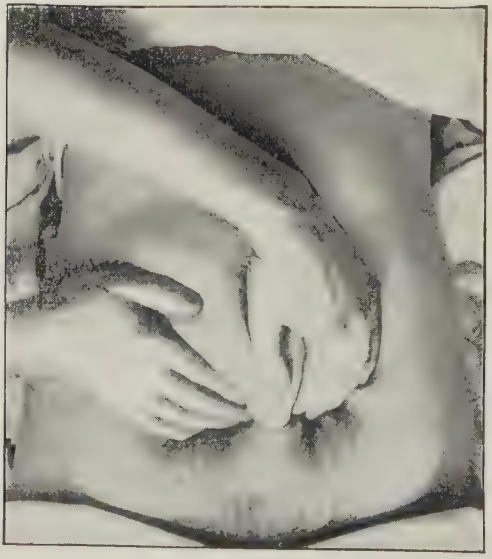

Fig. 40.—Palpating the abdomen. (From Rose: *Physical Diagnosis.*)

   (c) Constant pressure.
   (d) Displacement pressure (blow).
   Deep tenderness.
   Superficial tenderness (by pinching).
4. Muscle resistance.
5. Tumors.

Errors

1. Muscle resistance (reflex tension).
2. Muscle belly (mistaken for a tumor)—grasp with hand while patient raises body = harder.
3. Fat in wall (mistaken for tumor).
4. Cord colique (mistaken for stomach—or tuberculous mass).
5. Fecal mass.
6. Aortic pulsation (mistaken for aneurysm).

Bimanual Palpation = use of two hands.

(One in the vagina or rectum, the other in the surface of the abdomen.)

An educated sense of touch comes only from much practice.

Percussion—

Not often of value in abdominal examinations.

Should be light percussion.

Expected sounds—

1. Tympany.
2. Dullness.

Uses of—

1. To determine the liver borders.
2. To determine the splenic borders.
3. To determine whether bladder is distended.
4. To determine gastric size and position. (Stomach inflated through stomach tube.)
5. To determine amount of gas in stomach.
6. To determine size and position of intestines. (Inflated through tube with Davidson syringe.)
7. To determine whether a mass is left kidney or spleen by inflating colon. (Air over one and under other.)

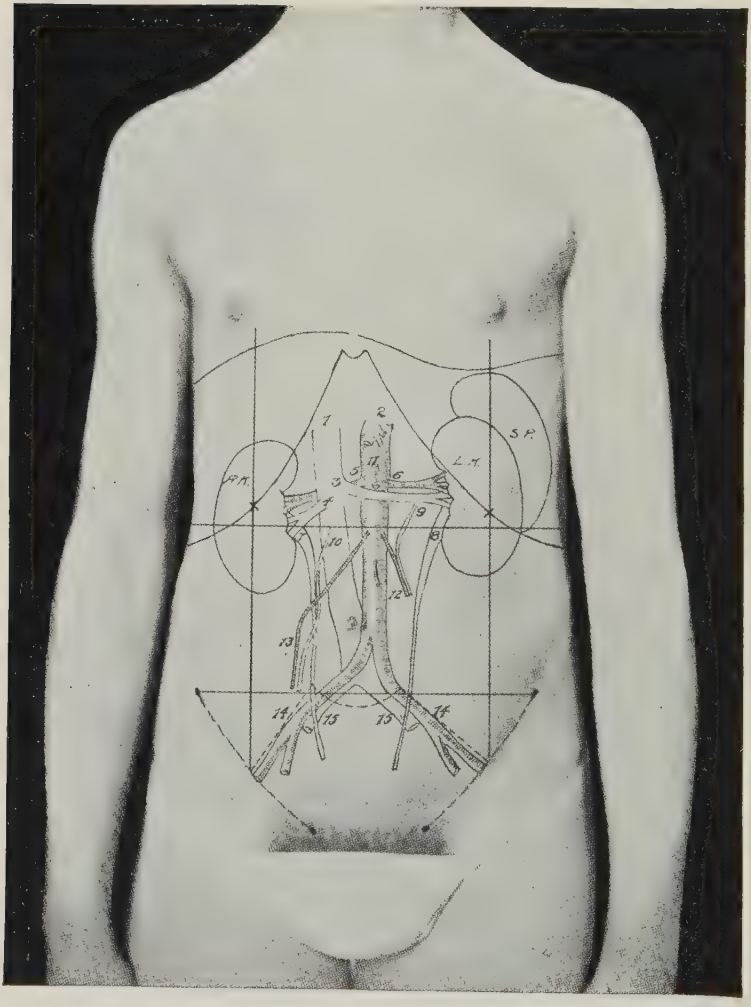

Fig. 41.—Regional anatomy of the abdomen. (From Rose: *Physical Diagnosis.*)

8. To determine absence of fluid.

   Fluctuating wave } phenomena of disease.
   Shifting dullness }

9. To outline Traube's semilunar space.

Boundaries of Traube's Semilunar Space

Above—Left lobe of liver and left lung.

Internally—Left costal margin.

Externally—Anterior border of the spleen.

Comparison of Gastric and Intestinal Tympany

	Quality	*Pitch*	*Intensity*	*Duration*
Gastric—	Tympany	Lower	Louder	Longer
Intestinal—	Tympany	Higher	Less	Shorter

Auscultation—

Of very little use.

What to listen for—

1. Gas in the stomach } Gurgles, bubbles,
2. Gas in the intestine } echoes, splashing.
3. Respiratory sounds in children.
4. Cardiovascular sounds. (Bruits, murmurs, fetal heart, uterine souffle.)
5. Friction rubs. (Liver, spleen, etc.—Pathologic.)
6. Gallstones. (Pathologic.)

Mensuration—

1. Circumference (at umbilicus).
2. Surface distances.
   (a) To locate. (Measured from umbilicus.)
   (b) To represent size.

STOMACH

Standing—

Hangs centrally.
Lesser curvature above iliac crests.
Greater curvature variable.

Form and position vary with—

1. Architecture of patient.
   (a) Thin persons have long central stomach hanging in the pelvis.
   (b) Stocky individuals (muscular) have transverse high stomachs.
2. Amount of food.
3. Tonicity of the wall.
4. Pressure of an adjacent viscus.
5. Tension of the muscles of the abdomen.

Lying prone—

Stomach is under liver.

Empty—

Almost vertical with walls in apposition except for gas bubble in fundus.

A meal—

Takes funnel-shaped form in body and antrum below the bubble.

Peristalsis—

Begins middle of lesser curvature and occurs about every 20 seconds.

Outline—

Smooth except for peristaltic indentations.

Cardia—

Anteriorly—7th left costal cartilage 1 inch to left.
Posteriorly—9th thoracic vertebra.

Pyloris—

Crossed by "transverse line," midway between symphysis pubis and suprasternal notch.

Inspection—

Nothing seen in health. In disease much may be seen (mass, peristalsis, etc.).

Fig. 42.—Skiagraph of the abdomen showing the relations of the liver (*L*), gall bladder (*GB*), stomach (*S*), duodenum (*D*), colon (*C*), and rectum (*R*) to the bony structures.

Palpation—

Stomach cannot be felt in health.

Tenderness in epigastrium frequent in health.

A splash can be produced frequently in health. Should not occur in empty stomach or 7 hours P. C.

Percussion—

Gives no information in health without artificial distention with air or water.

Stomach distended by air by a Davidson syringe through stomach tube.

Upper and lower borders should then be percussed.

(Soda [1 dram in water] followed by tartaric acid [1 dram in water] will also distend stomach.)

Water run in through a stomach tube may serve same purpose.

(1500 c.c. normal.) This is not as useful a method as air.

Auscultation—

1. Deglutition murmur. Site—cardia.
   [Use stethoscope.]
   A double sound after drinking water.
   (a) 1st sound (esophagus) 6 seconds after swallowing.
   (b) 2nd sound (stomach) 4 to 5 seconds later.
2. Succussion sounds.
3. Gurgling sounds.
4. Effervescence (fermentation).
5. Resonant echoes (heart).
   (Obviously a method of little value.)
6. Breath sounds—Râles (Pathologic).

Stomach tube—

1. Acidity.
2. Emptying time.
3. Quantity of contents.
4. Abnormal contents. (Blood, pus, bacteria, etc.)

Gastrodiaphany—

(Transillumination with electric bulb in stomach in dark room.)

Gives position of greature curvature.

X-ray—

Most useful single method.

(Not always available; therefore, other methods should not be neglected.)

Information It Affords—

1. Size.
2. Position.
3. Outline.
4. Movements.
5. Tonicity.
6. Mobility.
7. Emptying time (three to six hours).

Intestines

Duodenum—

(Ten inches of small intestines around head of pancreas.) In epigastric and umbilical regions, to right of midline.

Fixed in position.

Negative to examination in health.

Tenderness and x-ray changes only objective signs of disease.

Small Gut—

Twenty-two feet, occupying chiefly the umbilical, lumbar, and hypogastric regions.

Inaccessible to physical examination except through x-ray.

Its tympany is higher pitched and weaker than colonic.

Appendix—Three to four inches.

1. Hangs free toward pelvic brim, or
2. Retrocecal.

Not palpable.

McBurney's Point—Two inches from right anterior superior iliac spine on line to umbilicus. Normal position of appendix.

Clado's Point—Intersection of right semilunar line with the interspinous line.

X-ray may visualize size, form and position, fixation.

Bimanual palpation through rectum or vagina should be routine when disease is suspected.

Colon—Five feet of movable gut, except for fixation at the flexures, especially accessible of examination in the cecum.

Inspection—Negative in health.

Palpation—Position. Of little significance.

Size—After inflation with Davidson syringe, may be made out. Contraction (cord colique) may sometimes be felt.

Masses (feces, tumors, etc.) should be searched for.

Percussion—Useful in outlining size and position.

Auscultation—Chiefly to determine whether peristalsis exists.

X-Ray—

1. Size.
2. Position.
3. Outline.
4. Mobility.

Stool—

Gross—size, consistency, color, character.

Microscopic appearance—digestion and abnormal constituents.

Sigmoid—

1. Sigmoidoscope.
2. X-ray.

Rectum—

1. Rectal palpation.
2. Inspection (speculum).

Liver

A firm, wedge-shaped mass which nearly fills the abdomen of the fetus and in the adult occupies a large part of the upper abdomen.

Lobes—

Right (subdivides into spigelian, quadrate, and caudate).

Left.

Size—(Varies)—

Transverse diameter	9 inches
Vertical diameter	6 inches
Anteroposterior diameter	5½ inches

Weight—

Three to four pounds (1/40 body weight).

Anatomical Points—

Superior, anterior, right, posterior, and inferior surfaces. Upper and lower borders, umbilical notch and round ligament.

Relations—(Chief)—

1. Above—diaphragm, lungs, heart.
2. Right
3. Anterior } diaphragm and chest wall.
4. Posterior—adrenal, vena cava, esophagus.
5. Inferior—gall bladder, colon, duodenum, adrenal, kidney (right), stomach.

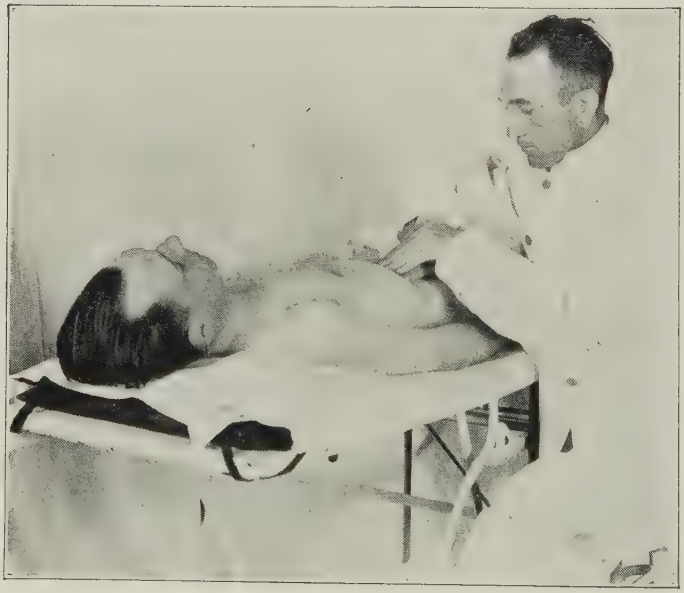

Fig. 43.—Palpating the liver. (From Rose: *Physical Diagnosis.*)

Movement—With respiration.

Surface Projections (Da Costa)

	Upper Border	Lower Border
Left midclavicular line	5 i. c. s.	5 i. c. s.
Sternum	6 cartilage	Transpyloric line
Rt. midclavicular line	4 i. c. s.	Costal margin
Axillary line	7 i. c. s.	10 i. c. s.
Scapular line	8 i. c. s.	
Posterior midline	8 T. V.	11 T. V.

Standing, the lower border of liver can be shown by x-ray to reach caudad to the interiliac line.

Inspection—

No information afforded in health—rarely in disease.

Palpation—

Lower border. In infants ½ inch below costal margin, and palpable. In thin adult often felt. Rarely felt in others in health because of muscle, fat, and gas.

Technic—

(a) Relaxed patient breathing with mouth open in the dorsal decubitus. With tips of finger of right hand feel for advancing margin of liver during inspiration.

(b) Fingers of right hand may be hooked over costal margin from above and the border felt for in the same way.

(c) Bimanual palpation using the left hand posteriorly for support.

What to feel for—

1. Tenderness.
2. Consistency (soft, firm).
3. Contour (smooth, rough, nodular).
4. Distance below costal margin in M. C. L.
5. Pulsation.

Percussion—

Hepatic area (vertical surface measurements).

Midline	*M. C. L.*	*Midaxillary L.*	*Scapular L.*
4 inches	4 inches	6 inches	3 inches

AREAS OF HEPATIC DULLNESS AND FLATNESS.

Area of dullness—

Part of upper lobe of liver covered by lung.

Percuss from above down, beginning at the 2nd i. c. s.

	M.C.L.	*Midaxillary L.*	*Scapular L.*
Line of dullness begins	4 i. c. s.	7 i. c. s.	8 i. c. s.

AREA OF FLATNESS

(Liver in contact with chest wall)

Note high-pitched and flat

	UPPER LINE OF FLATNESS	LOWER LINE OF FLATNESS
MIDLINE	———	3 in. below xiphoid
MIDCLAVICULAR LINE	6th rib	Costal margin
MIDAXILLARY LINE	8th rib	Costal margin
SCAPULAR LINE	10th rib	———

Uses of Percussion—

1. Tenderness (jarring with fist).
2. Size of liver (upper and lower borders).
3. Position of liver (dislocation may be up or down).

Auscultation—

Listen for friction sound.

(Peritonitis, localized.)

X-ray—(Pneumoperitoneum).

Most accurate way to make out the size, shape, and position of the liver.

Functional Test—

1. Stool (bile and fat).
2. Phenol-tetrachlor-phthalein test.
3. Icteric index.
4. Van den Bergh test.

Gall Bladder

Pear-shaped receptacle 3 to 4 inches long and holding about 1½ ounces.

Fundus at 9th right costal cartilage.

Inspection—No value.

Palpation—At tip of 9th right cartilage for

1. Tenderness.
2. Mass (descending with expiration).

Percussion—No value except for jarring to elicit tenderness.

Auscultation—Very rarely of use. (Listen for crepitation of stones.)

X-Ray—With tetraiodophenolphthalein sodium salt excellent shadows of gall bladder. Known as the Graham test. This method is 90 per cent accurate. Old method of some value (20 to 30 per cent).

Duodenal Tap—Of some value.

Murphy's Sign—Hook fingers over ribs and note inability to breathe.

(Pain of gall bladder disease.)

Pancreas

A deep-seated gland 6 inches long, lying transversely across the epigastrium. Head surrounded by duodenum. Tail against spleen. Covered by stomach. Cannot be made out in health. Rarely felt in disease. In order to learn about its function, we examine the feces, urine, and blood as follows:

Stool—Fat.

Urine—Glycosuria.

Blood—Hyperglycemia.

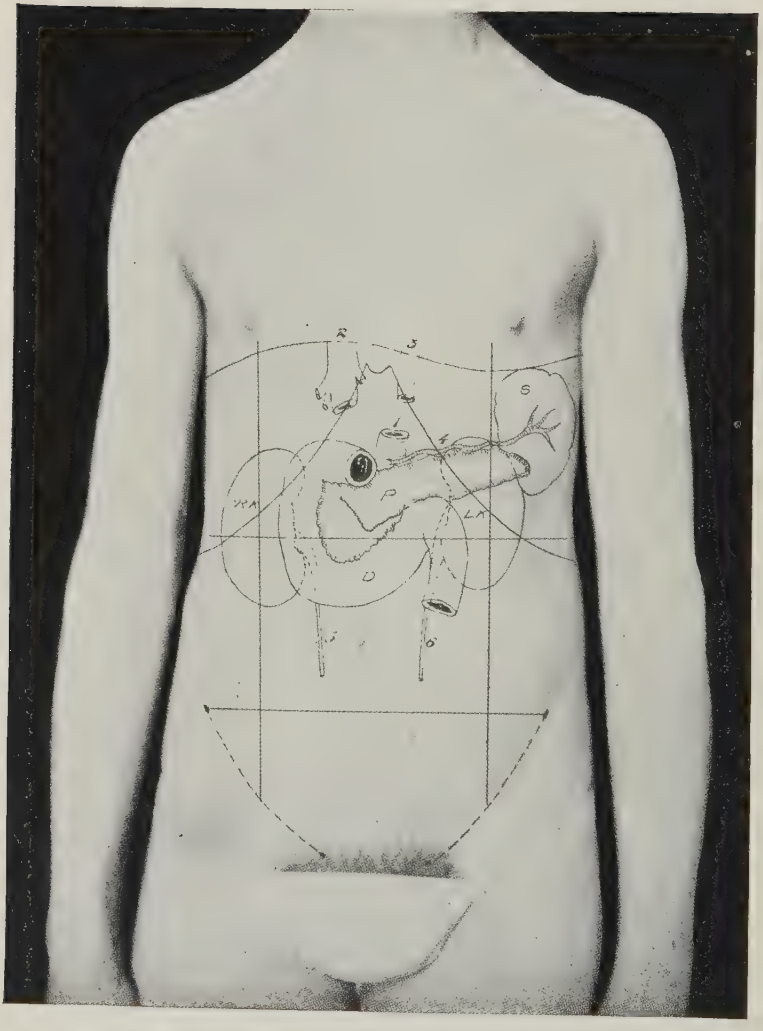

Fig. 44.—Regional anatomy of the abdomen. (From Rose: *Physical Diagnosis.*)

Spleen

Site = Left hypochondrium.

Weight = 7 ounces.

Length = 5 inches.

Shape = Ovoid, modified by adjacent organs.

Moves = With respiration and stomach.

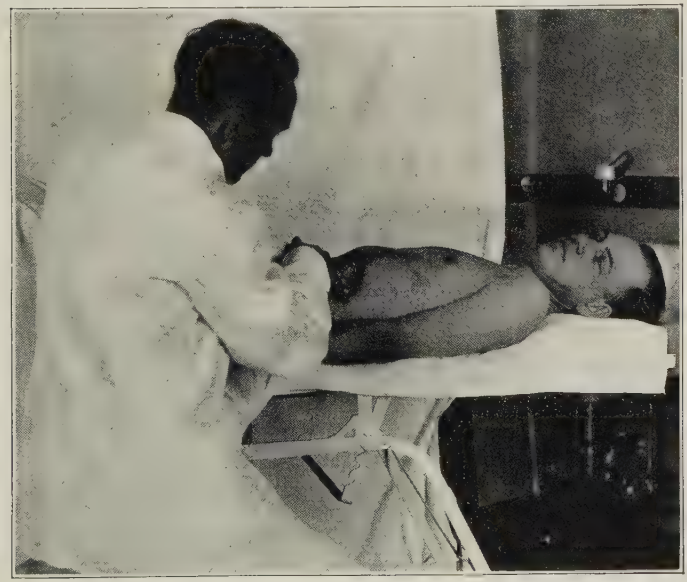

Fig. 45.—Palpating the spleen. (From Rose: *Physical Diagnosis.*)

Relations—

Posteriorly—diaphragm, ninth, tenth, eleventh ribs, lungs and pleura.
Inferiorly—splenic flexure.
Mesially—left kidney.
Anteriorly—stomach.

Borders—Anterior (notched), inferior, posterior.

Position—Oblique.

Surface Anatomy—

Covered by ninth, tenth, eleventh ribs.
Between level of ninth T. V. and first or second L. V.
Organ is chiefly in the back.

Inspection—No value.

Palpation—Not felt in health.

Technic—

Method (a)

Patient in dorsal decubitus, relaxed.
Examiner on right with right hand on belly pushes up with finger tips under left costal margin. Left hand in left loin elevates spleen.
Border is felt impinging against finger tips with each inspiration.

Method (b)

With right hand grasp left flank. Left thumb feels for advancing border in inspiration.

Method (c)

Turn patient on right side and follow bimanual method (a).

What to feel for—Anterior border—

1. Size, form, consistency.
2. Tenderness.

Percussion—Difficult. Use light stroke.

Position—Standing or right decubitus.

Area of Splenic Dullness.

Between

1. Middle and posterior axillary lines.
2. Upper border tenth rib and lower border of eleventh.

Tympany—mesially and below.

Resonance—above

(Note use of colonic inflation over which spleen lies.)

Auscultation—No sound in health.

(Friction sound in perisplenitis.)

X-ray will often demonstrate an enlarged spleen.

Kidneys

Two bean-shaped glands, deep lying and retroperitoneal.

Weight—4½ ounces.

Length—4½ inches.

Right kidney lower than left.

Occupy hypochondriac, lumbar, epigastric, and umbilical regions.

Relations—

1. Behind—Deep muscles of abdomen.
2. In front—
   (Right) liver, adrenal, duodenum, colon, small intestine.
   (Left) stomach, spleen, pancreas, adrenal, colon, and small intestine.

Surface Anatomy—

Opposite 12th T. V. and first and second L. V.

One inch above iliac crest.

Extend from seventh costal cartilage to tenth costal cartilage.

Inner border 1½ to 2 inches from midline.

Inspection—Nothing seen in health.

Palpation—In normal thin persons kidney is occasionally felt, usually the right.

What to feel for—

1. Size, consistency, form.
2. Mobility.
3. Tenderness.

Fig. 46.—Pyelogram showing the position of the kidneys, renal pelvis, and ureters.

Technic—(Dorsal decubitus or standing.)

Method (a)

Bimanual palpation—supporting loin with left hand while palpating with fingers of right.

Method (b)

Grasping flank with whole right hand, feeling for kidney with thumb.

Percussion—No value except when colon is inflated to rule out tumor of spleen.

Auscultation—Not used.

X-Ray—Of great value to show size, form, position, structure of kidney.

Catheterization—

Urinalysis—

Ureter

Only by

X-ray.

Catheter (cystoscope).

Bladder

Lying in the pelvis it rarely rises above the symphysis pubis. (Externally.)

Inspection—

Not seen unless very much distended.

Cystoscopy. (Internally.)

Palpation—Same applies. Tenderness.

Percussion—Dullness above the symphysis pubis determines amount of distention.

Auscultation—No use.

X-Ray—For size, shape, and presence of a foreign body.

Urinalysis—For evidence of injury, infection, etc.

Adrenals not accessible. (Sergents "white line"—appears one minute after abdomen is stroked with a blunt instrument and lasts three or four minutes. A sign of disease.)

Prostate and Seminal Vesicles—

Rectal examination for size, shape, consistency, fixation, tenderness, and character of material obtained on massage.

Abdominal Lymph Glands—

Palpable only in disease.

Needle—

Aspiration of the abdominal cavity used to determine the amount and character of fluid. (Pathologic.)

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CHAPTER XV

BACK

The back includes a number of important structures. They are:

1. Skin.
2. Muscles—(A) Erector spinae, a lumbar mass which is continued anteriorly into the—
   (1) Iliocostalis, with its lumbar, thoracic, and cervical divisions.
   (Action—Draws spine back and to side and assists in expiration.)
   (2) Longissimus dorsi with a similar action.
   (3) Splenius capitis.
   (Action—Draws head backward—also rotates.)
   (B) Superficial group — spino-humeral muscles — Phylogenetically belong to upper extremity. Broad flat muscles.

Trapezius, latissimus dorsi, and rhomboids are the chief.

3. Vertebral body.
   Vertebral transverse process.
   Vertebral spine.
   Vertebral joints.
   Spines prominent in children and the thin.
   Spines made prominent in leaning forward.
4. Cord and nerves.
5. Organs ventrally in contact.

Surface Anatomy—

1. First five cervical vertebrae not felt.
2. Sixth cervical vertebra often felt.

3. Seventh cervical vertebra usually felt and seen. (Vertebra prominens.) It is used as a point of departure in counting the vertebrae.
4. Eighth and ninth thoracic prominent.
5. Mesial furrow (deep in upper lumbar region) produced by erector spinae group of muscles.
6. Iliac crest—crest corresponds to fourth lumbar vertebra.
7. Posterior superior spine of ilium marked by dimple at level of second sacral spine.
8. Scapula—Extends from second to seventh rib. Spine and acromion felt throughout.

Landmarks of Spine—

Atlas—Hard palate.
Axis—Upper teeth.
4C.—Hyoid bone.
6C.—Cricoid bone.
2D.-3D.—Upper sternum.
4D.—First and second parts of sternum.
10D.—Tip of ensiform.
Ant. extremity of rib 1 = rib 4 at spine.
Ant. extremity of rib 2 = rib 6 at spine.
Ant. extremity of rib 5 = rib 9 at spine.
Ant. extremity of rib 7 = rib 11 at spine.

Position in Which to Examine Patient—

Standing.
Lying on back.
Lying on abdomen.
Still and during motion.

The following points are important in examining the back:

1. The surface—general contour.
   Smoothness.

2. Scapulae—position.
   (Flare with weak muscles.)
3. Vertebrae—

   I. *Prominence of spine.*

   II. *Curvatures.*

   (a) Kyphosis (backward convexity) chiefly thoracic.
   Curve is gradual in "round shoulders."
   In round shoulders due to posture often, and can be corrected.
   Same type also produced by age and carrying heavy head burdens.

   (b) Lordosis (exaggerated normal lumbar convexity).
   Frequent in rapidly growing youth.
   Constant in pregnancy.

   (c) Scoliosis—(lateral bending and rotating).
   (Skin pencil to mark spine often helpful.)
   Seen in school children.
   Seen in persons with legs of unequal length.
   Seen in persons carrying burdens in one hand.

   III. *Movements*—

   1. Ventral flexion.
   2. Dorsal flexion.
   3. Lateral bending.
   4. Rotation.

   To see if equal in all directions.
   To see if painful.
   To see if limited in extent.

IV. *Tenderness*—

4. Sacrum—Coccyx—
   (a) Movement.
   (b) Compress iliac wings.
5. Iliosacral Joint—
   Tenderness—
   (a) Direct pressure over joint.
   (b) Compress iliac wings.
   Mobility of joint.
   Posture (in disease lean to one side).
6. Lumbar Muscles—
   1. Resistance (spasm).
   2. Tenderness.
   3. Effect of exercise.
   4. Lumps.
7. Points on Surface of Back to Examine for Tenderness—
   1. Vertebrae.
   2. Costovertebral angle.
   3. Sacroiliac joints.
   4. Coccyx.
   5. Lumbar muscles.
   6. Sciatic nerve.
8. X-ray—To show structure of vertebrae.

CHAPTER XVI

EXTREMITIES

Nails—Specializations of the epidermis.

Parts—

1. Nail plate—
   (a) Body (visible portion).
   (b) Lunula (semilunar posterior 1/5).
   (c) Root (imbedded portion).
2. Nail groove (depression in which 3 edges rest).
3. Nail fold (skin overlapping nail).
4. Nail bed (derma under nail body).
5. Matrix (part under lunula and root. Consists of derma covered by stratum germinativum).

The nail plate is quadrilateral.

Sides parallel and straight.

Laterally convex.

Longitudinally very slightly convex.

Color Zones—

1. White (matrix).
2. Rosy (body).
3. Yellow (line of juncture of skin and nail).
4. Gift spots (white). (Leukopathia unguium.) (Air in layers.)

Growth—

Finger nails grow three times as fast as toe nails.

Growth is greater in summer.

Growth is greater in youth.

Time required for a complete new nail to grow out four to six months.

Ridges—

(a) Longitudinal—normal to slight degree on upper aspect.

(b) Transverse—nutritional—follow disease—used to determine time of disease.

Hands—

Right hand larger than left, in right-handed person.

Surface Markings—

Hollow of the hand.
Thenar eminence.
Hypothenar eminence.
Anatomic snuff box.
Four palmar cutaneous creases.
Finger prints.

Note: Absence of hair and sebaceous glands in palm and few surface veins.

What to Examine—

1. *Shape—*
   (a) Build.
      1. Brevilinear.
      2. Longilinear.
   (b) Occupation.
      1. Mining—blue dots.
      2. Toil—horny.
      3. Violin—flat hard finger tips.
      4. Sewing—worn finger tips.
      5. Smoking—yellow stains.
   (c) Age.
      1. Youth (fat and soft).
      2. Old age { wasted. / pigmented. / prominent veins.
   (d) Disease—(many deformities).
2. *Color*—(cyanosis, anemia, sunburn).

3. *Moisture*—
    1. Cold and moist (nervous).
    2. Cold and dry (serious).
    3. Warm and moist (goiter).
4. *Swelling* (edema, etc.).
5. *Movements*—
    1. Grip (strength).
    2. Handshake (character).
    3. Tremors } Abnormal.
    4. Spasms }

Arms and Legs—

Right arm larger than left (use).

1. Size—
    (a) Absolute.
    (b) Relative.
2. Length (measurement).
3. Power.
4. Conformation.
5. Joints (movement, tenderness, size).
6. Lymph glands.
7. Veins (size and number).

Feet—

Arches—
(a) Longitudinal (ink print).
(b) Transverse.
Flexibility of joints.
Swelling.
Color (see hands).
Moisture (see hands).
Shape (parallels the hands).
Size (distorted by shoes). Bare feet.
Temperature.

CHAPTER XVII

LYMPHATIC SYSTEM

(a) Lymph spaces.
(b) Capillaries.
(c) Lymph vessels (accompanying veins).
(d) Right lymphatic duct (draining right thorax).
(e) Thoracic duct (draining rest of body into left subclavian vein).
(f) Lymph nodes.

Regional Drainage of Lymph Nodes

Head—

1. Suboccipital nodes drain the scalp.
2. Postauricular nodes drain the scalp.
3. Parotid nodes drain—
   (1) Scalp.
   (2) Middle ear.
   (3) Cheek.
4. Submental nodes drain tongue.
5. Submaxillary nodes drain
   (1) Scalp.
   (2) Nasal region.
   (3) Cheek.
   (4) Teeth.
   (5) Tongue.
   (6) Lips.

Neck—

6. Superficial cervical nodes drain
   (1) External ear.
   (2) Skin of face.
   (3) Skin of neck.

(4) Efferents from—
(a) Suboccipital.
(b) Postauricular.
(c) Submaxillary.
(d) Parotid.

7. Deep cervical nodes drain (upper group)—
(1) Scalp.
(2) Ear.
(3) Tongue.
(4) Tonsils.
(5) Nose.
(6) Face.
(7) Teeth.
(8) Pharynx.
(9) Lips.
(10) Eyelids.

8. Deep cervical nodes (supraclavicular) (lower group) drain—
(1) Scalp.
(2) Neck.
(3) Upper pectoral.
(4) Axillary nodes (communicate).
(5) Liver (occasionally, in part).

Arms—

9. Epitrochlear node—drains hand and arm.

Axillae—

10. Axillary nodes drain—
(1) Arm.
(2) Chest wall.
(3) Abdominal wall (upper one-half).
(4) Hand.
(5) Breast.

Chest—

11. Bronchial nodes (tracheal, bronchial, pulmonary) drain—
(1) Heart.
(2) Bronchi.
(3) Lungs.
(4) Posterior mediastinum.
(5) Trachea (lower part).

Abdomen—

12. Abdominal nodes—
    - A. Celiac nodes drain—
        - (1) Spleen.
        - (2) Liver.
        - (3) Digestive tract.
    - B. Mesenteric nodes drain intestines.

Pelvis—

13. Pelvic nodes drain pelvic viscera.

Lower Extremity—

14. Inguinal nodes drain—
    - (1) Lower extremities.
    - (2) External genitalia.
    - (3) Buttocks.
    - (4) Lower half of abdominal wall.
15. Popliteal nodes drain—
    - (1) Foot.
    - (2) Leg.

Method of Examination—

(1) Inspection.

(2) Palpation { size. / consistency. / tenderness.

(3) Percussion.

(4) Auscultation.

(5) Aspiration.

(6) Biopsy.

(7) X-ray.

In health no lymph nodes should be seen.

Palpation often discloses submental and submaxillary nodes, rarely cervical nodes. Elsewhere lymph nodes should not be felt.

X-ray shows no normal glands. Calcified areas in bronchial glands are frequent findings.

Technic of Examination—

Inspect and palpate

1. Base of occipital triangle (occipital nodes 1 to 3).
2. Tip of mastoid (posterior auricular nodes—2).
3. Parotid gland (parotid nodes).
4. Lower border of ramus of mandible (submaxillary nodes 3 to 8).
5. Between digastric muscles (submental nodes 2 to 3).
6. Along sternomastoid muscle (superficial cervical nodes).
7. Beneath deep fascia and sternomastoid muscle (upper deep cervical nodes).
8. Brachial fascia over internal condyle of humerus. (Epitrochlear node.)
9. Between axillary folds (axillary nodes).
10. Abdominal cavity (abdominal nodes).
11. Inguinal region below Poupart's ligament (inguinal nodes).

Stereoscopic plates of chest for size of bronchial glands.

Auscultation over the spinous processes of the cervical vertebrae during whispered words gives pectoriloquy.

Below the bifurcation of the trachea this sign should disappear in health. D'Espine's sign.

THE SPINAL LEVEL AT WHICH PECTORILOQUY CEASES
(Classified according to age)

Under three years	7th Cervical vertebra
Three to five years	1st Dorsal vertebra
Over five years	3rd Dorsal vertebra
Adult	4th Dorsal vertebra

In disease enlarged glands about the hilus of the lung cause pectoriloquy to be heard below the levels above indicated.

In eliciting this sign the patient whispers "*thirty-three.*" It is chiefly used in examining the chests of children.

X-ray of a pneumoperitoneum should be used to investigate abdominal nodes.

Biopsy enables one to demonstrate finally whether a gland is normal or not.

Aspiration may settle the nature of the contents of mass, whether it is gland or not.

In examining the lymph glands one should proceed systematically from head to foot.

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1. D'Espine, Adolphe: Diagnosis of Tuberculosis of the Bronchial Glands in Children, Brit. Med. Jour., 1910, ii, 1136.

2. Stoll, H. F.: The Diagnostic Significance of D'Espine's Sign, Am. Jour. Dis. Child., 1915, x, 183.

CHAPTER XVIII

NERVOUS SYSTEM

In the examination of the nervous system a thorough understanding of the anatomy and function of the cord, brain, and nerves is a prerequisite. The principal structures which have to be considered are briefly outlined below, but a very much more detailed knowledge is required before a worth-while examination of this system can be made.

A. Cerebrospinal nervous system—
   1. Brain—
      (a) Cerebrum.
         (1) Frontal lobe (intellect).
         (2) Postcentral lobe (sensory).
         (3) Precentral lobe (motor).
         (4) Parietal lobe (astereognosis).
         (5) Temporal lobe (hallucination of smell).
         (6) Broca's area (speech).
      (b) Basal ganglia.
      (c) Crura cerebri.
      (d) Pons.
      (e) Medulla.
      (f) Cerebellum.
   2. Cord.
   3. Cranial nerves.
   4. Spinal nerves.

B. Vegetative nervous system—
   1. Sympathetic.
   2. Parasympathetic (autonomic).

Sympathetic is a chain of prevertebral ganglia.

Autonomic occurs on the surface of organs, as ganglia and plexuses, and shows various spinal connections.

Functions—

Cerebrum—

1. Motor impulses originated.
2. Sensory impressions registered.
3. Reflexes inhibited.
4. Associations made.
5. Higher functions.

Cerebellum—

1. Muscle tone.
2. Muscle strength.
3. Coordination.
   (a) Equilibrium.
   (b) Locomotion.

Medulla—Site of Centers of—

1. Respiration.
2. Heat.
3. Vessel tone.
4. Vagus.

Basal Ganglia—Reflex centers.

To be kept in mind always—
- The end organ.
- The path.
- The receptor.

Object of Examination—

To determine if all parts of this elaborate system are intact.

ANATOMIC STRUCTURES	FUNCTION OF STRUCTURES	TESTS OF FUNCTION
1. End organs 2. Peripheral nerves (afferent) 3. Posterior ganglia	1. Origin of impulses 2. Conveyance of impulse 3. Relay of impulse	Mass disturbance of all sensation at spinal level, or by nerve distribution
4. Cord — a. Spinothalamic fiber tract (crossed)	4. Conveyance of pain, temperature, touch sensations	Pin prick (pain) Hot and cold test tubes of water applied (temperature) Camel's hair brush (touch)
4. Cord — b. Posterior funiculus (Dorsal cols.)	5. Conveyance of muscle, tendon, bone sense Deep pressure Deep pain	Equilibrium Pencil rubber—tuning fork Pencil rubber for pressure
4. Cord — c. Spinocerebellar fiber tracts (Dorsal and ventral)	6. Conveyance of muscle, tendon, bone sense	Passive and voluntary movements of extremities
5. Optic thalamus 6. Sensory convolutions (cortex)	7. Crude perception of sensation (pain, temperature, touch) 8. Delicate and discriminatory perception of sensation (Detection of space, quantity, and difference in size, shape, and texture)	See above Special Discrimination: 3 Dimensions: passive movement of extremities 2 Dimensions: compass* 1 Dimension: spot Quantity Discrimination: 1. Warm and warmer test tubes Difference in— 1. Size (coin) 2. Shape (knife) 3. Weight (coin) 4. Texture (silk and wool)

*Tongue 1 mm. Finger tip 2 m.m. Back 65 mm.

Neurologic Examination—

1. Expression.
2. Walk—gait.
3. Speech—lost or impaired.
4. Sensory system.
   (a) Tactile—(eyes shut—stroke skin with camel's hair brush or piece of cotton).
   (b) Temperature (eyes shut).
      1. Heat—warm water in test tube.
      2. Cold—cold water in test tube.
   (c) Deep pressure (weights or finger. Patient estimates amount).
   (d) Pain (eyes shut—stick with pin).
   (e) Vibration (firm pressure with end of tuning fork—bone). 128 vibrations second (C^0).
   (f) Stereognosis (eyes shut—patient names object put in hand).
   (g) Muscle and joint sense (eyes shut—can patient tell whether arm is flexed or extended?) Flexion of 1° to 2° recognized normally.
   (h) Compass test. Two points normally discriminated at 0.5 to 1 cm.
   (i) Spot finding.
5. Motor System—
   Muscle power—(Test various muscle groups for strength).
   Look for tremors and spasms.
6. Muscle Tone.—(Are muscles firm or flabby? Resistance to passive movements—cerebellum.)
7. Cranial Nerves—
   I. Smell. (Acetic acid, alcohol—cf. temporal lobe also.)

Motor System

Anatomic Structures	Function of Structures	Tests
1. A. Corticospinal Motor System (a) Motor cortex (b) Pyramidal tract (Through corona radiata, internal capsule, crus, pons, medulla, cord)	Origin voluntary motor impulses Conveyance voluntary motor impulses	(1) Muscle tone (2) Muscle power (voluntary) (3) Reflexes (normal and abnormal)
B. Striospinal Motor System		
(a) Corpus striatum (Lenticular N. and Caudate N.)	Origin autonomic motor impulses	Expression (face) Steadiness of hands
(b) Red N. and rubrospinal tract	Origin and conveyance autonomic motor impulses	Automatic movements (a) winking (b) swinging arms
(c) Deiters N. and vestibulospinal tract	Origin and conveyance autonomic motor impulses	Look for choreic and athetoid movements
(d) Anterior corpus quadrigeminum and tectospinal tract	Origin and conveyance autonomic motor impulses	
2. Anterior Horn Cells	Relay and reflex	Various spinal reflexes and motor power
3. Peripheral Motor Nerves	Conveyance of motor impulses	Muscle power Muscle size Electrical test for reaction of degeneration

Note—Seven months' fetus has power of movement when pyramidal tract has not developed, due to striospinal motor system.

II. Vision—

(a) Test acuteness.
(b) Plot fields of vision.
(c) Color vision.
(d) Fundi with ophthalmoscope.

III, IV, VI. Movements of the Eye—

(a) Mobility of globes (eyes follow finger).
(b) Ptosis.
(c) Parallelism (squint).
(d) Nystagmus.
(e) Pupillary reaction to light.
(f) Pupillary reaction to distance.
(g) Prominence of globes.

V. Trifacial Nerve—

(a) Chewing muscles tested for power.
(b) Taste—anterior part of tongue tested with salt and acid.
(c) Corneal sensation tested by touching with cotton.

VII. Facial Nerve—

(a) Expression.
(b) Showing teeth.
(c) Whistling.
(d) Facial wrinkles.

VIII. Auditory Nerve—

(a) Hearing (well modulated voice at 20 feet [20/20], one ear closed).
(b) Bone conduction (tuning fork to mastoid).

IX. Glossopharyngeal Nerve—

(a) Taste (test posterior $\frac{1}{3}$ of tongue).

(b) Pharyngeal reflex. (Place tongue depressor against pharynx.)
(c) Test swallowing.

X. Vagus Nerve—
(a) Heart rate (slows when stimulated).
(b) Respiratory rate (quickens).

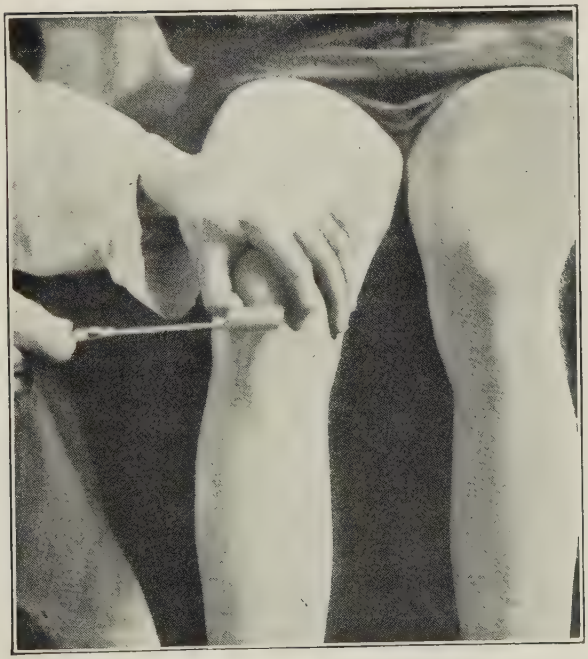

Fig. 47.—Eliciting the patellar reflex. (From Rose: *Physical Diagnosis.*)

(c) Palate symmetry.
(d) Larynx (voice and cords).

XI. Examine trapezius and sternomastoid muscles for power.

XII. Hypoglossal Nerve—

(a) Direction in which tongue is protruded.

(b) Size and form of tongue.

(c) Swallowing and articulation.

8. Reflexes—

A. Deep—

I. Knee Jerk. (Tap knee while crossed and relaxed with hammer or hand.) The reflex may be reinforced, if difficult to elicit, by having patient close eyes and squeeze hands together at the moment of the blow. Center, L. ii-iii.

II. Achilles jerk. (While kneeling in chair strike Achilles tendon.) Center, L. v-S.i.

III. Biceps jerk. (Striking biceps tendon.) Center, C. v.

IV. Triceps jerk. (Striking triceps tendon). Center, C. vi.

V. Jaw reflex. (Striking tip of jaw.) Center, Pons.

B. Superficial—

I. Abdominal. (Scratching abdomen in any quadrant causes muscle contraction). Center, D. viii-xii.

II. Cremasteric. (Stroking skin of inner thigh causes testicle to rise.) Center, L. ii.

III. Cervical. (Stroking neck causes pupil to dilate.) Center, C. viii.

IV. Plantar. (Plantar flexion of toes when bottom of foot is stroked.) Center, S. i.

9. Coordination. (Eyes closed)—

(1) Finger to nose test.

(2) Finger to finger test.

Fig. 48.—Babinski's sign. (From Rose: *Physical Diagnosis.*)

(3) Heel to knee test.

(4) Walking.

(5) Walking backward.

(6) Walking a line.

(7) Standing with feet together and eyes closed.

(8) Diadokokinesis (brought out by rapid pronation and supination).

(9) Writing.

10. Ankle clonus (forcible dorsal flexion of foot).
11. Trophic condition of skin and nails.
12. Rectal, vesicle, sexual control.
13. Vasomotors—sweating.
14. Electrodiagnosis—

Tests—	*Kinds—*
(1) Nerve integrity.	(1) Faradic (induced, alternating current).
(2) Muscle.	(2) Galvanic (battery, interrupted current).

Faradic—(Least used).

Technic—

(a) Wet indifferent pole placed against skin on back of neck.

(b) Other pole touched to the "motor point" desired.

Result—Quick contraction of muscle.

Galvanic—

Technic—

Same as above except—

(a) Make and break of current is switch controlled.

(b) Both poles are used (anode [+] cathode [−]).

Results—

Muscle contraction on closing and opening the switch.

Cathode closing contraction = CCC.

Cathode opening contraction = COC.

Anode closing contraction = ACC.

Anode opening contraction = AOC.

Normal Formulae—

CCC active response.
COC no response.
ACC less active response.
AOC occasional response.
CCC>ACC> or = AOC>COC.
"Motor points" should be followed on a good diagram.

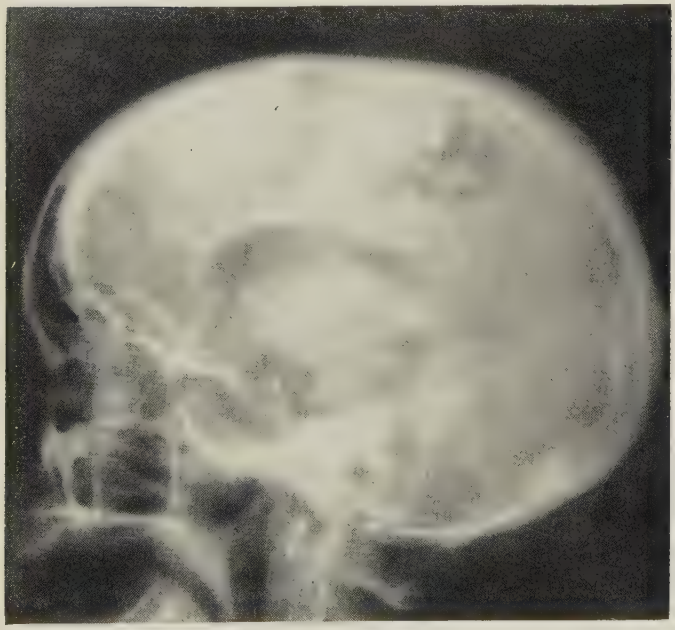

Fig. 49.—Encephalogram. Air injected into the spinal canal has filled the ventricles and covers the surface of the brain.

15. X-ray—Brain and cord.
Inject air into ventricles—ventriculography, and x-ray.
Inject air into the spinal canal and x-ray the skull—encephalography.

Inject lipiodol into spinal canal, and x-ray.

16. Spinal puncture. During spinal puncture the cervical vessels are compressed with the fingers. An increase in spinal fluid pressure results. This is a negative Queckenstedt's sign.
17. Double puncture (cisterna magna).

Mental Examination

No physical examination should be completed without some consideration of the patient's mental faculties. Mental behavior is capable of accurate analysis. Mental diseases properly belong to the field of psychiatry, but every physician should be familiar with certain elementary faculties of the normal mind. They are not difficult to study and during the course of a routine examination most of the data can be drawn out. A brief and simple outline to follow in examining the normal mind is given below.

Examine—

1. *The perception*—defined by James as "Consciousness of particular material things present to sense." A few well-directed questions will bring out the keenness and accuracy of perception. It may be:
   (a) Decreased (stupor).
   (b) Absent (coma).
   (c) False (illusions, hallucinations).
2. *The memory* is next tested by questions to determine its accuracy for
   (a) Immediate past.
   (b) Recent past.
   (c) Remote past, and for
   (d) Falsification.

3. *Orientation*—test for disturbance in appreciation of
   (a) Time (time of day, month, year).
   (b) Space (knowledge of where he is).
   (c) Person (identification of others).
4. *The attention* is then studied—does he wander or can be think and talk on one subject in a sustained manner?

   Lessened attention results in suggestibility and distractibility.
5. *The emotions* should be carefully observed (emotion is defined by James as the tendency to feel). It is important to remember that the emotions should agree with the environment. Is the emotional response adequate? The play of emotion runs through
   (a) Sadness.
   (b) Joy.
   (c) Fear.
   (d) Apathy.
6. *Volition*, i.e., the will. Every normal mind possesses the faculty to will. It may be disturbed
   (a) Explosive.
   (b) Obstructed (catatonia, negativism).
7. *Personality*—a study of the patient's personality should be considered from two points of view. How he looks upon
   (a) Himself.
   (b) Others.
8. *Conduct*—this can be observed as well as inquired about.
9. *Ideation*—defined as the distinct mental impression of objects. Disturbance of, leads to
   (a) Obsessions (fear of harmless objects).
   (b) Compulsions (an urge to jump from a window).
   (c) Delusions (as of grandeur).

CHAPTER XIX

RECTAL AND VAGINAL EXAMINATIONS

Examination of Rectum

1. *External Inspection—*
   Patient in Sims' position (left lateral).
   Good light (day or artificial).
   Part buttocks and examine anus, perineum, and genitalia.
2. *Digital Palpation—*
   Patient in Sims' and lithotomy positions.
   Finger covered by glove or finger cot.
   Well lubricated.
   Palpate carefully and gently for
   (a) Rectal walls (soft and velvety).
   (b) Feces (position, amount, character).
   (c) Sphincters (spasm, pain).
   (d) Prostate. (Heart-shaped—1½ inches long—apex down.) Faintly felt through anterior wall. Feel for—

   Size. Pulsation.
   Tenderness. Consistency.
   Shape.

   Massage and examine material that appears at meatus, or that is passed with next urine.

   (e) Seminal vesicles.
   Normally not felt.
   Lie above lobes of prostate on each side.
   (f) Uterus.
   Felt through anterior wall.
   Determine—(1) Size. (2) Shape. (3) Position.

(g) Adnexa.
May also be felt by this method.
(h) Coccyx.

3. *Internal Inspection*—
Anoscopy
Proctoscopy } In knee-shoulder position.
Sigmoidoscopy

The examination of the external genitalia can be made at this stage by inspection and palpation.

Vaginal Examination

1. *External Inspection*—
Labia, clitoris, vestibule, fourchette, and fossa navicularis.

2. *Digital Palpation*—
Lithotomy position.
Gloves and lubricated hand.
Two fingers for married.
One finger for unmarried.
Enter vagina by sweeping fingers over perineum and then passing backward toward sacral hollow.

What to feel for—

Spasm.	Heat.
Tenderness.	Moisture.
Masses.	Feces in rectum.

Cervix—Size, shape, position, mobility, lacerations.
Os—Size, shape, contents.

3. *Bimanual Palpation*—
Middle finger of right hand on cervix.
Left hand on abdomen above pubis.
Raise uterus with right hand and feel for fundus with left.

Put right middle finger in anterior fornix and feel for fundus.

Put right middle finger in posterior fornix and feel for fundus.

Put right middle finger in lateral fornices and feel for ovaries, tubes, and parametria.

Normally adnexa not felt.

Normally in anterior fornix, fundus felt.

In posterior fornix nothing felt.

In lateral fornix nothing felt.

Rectal palpation also valuable.

4. *Internal Inspection*—

(Various speculae used.)

Observe—

Vaginal walls, cervix, os.

CHAPTER XX

YOUTH AND OLD AGE

As there are certain obvious characteristics of youth, so there are manifestations peculiar to old age. In the study of the normal for its own worth, as well as for a point of departure in approaching the abnormal, the common structural changes incident to age are important. We must know the normal child and old man as well as the adult of thirty.

Peculiarities of Childhood—

1. Shape and size of head. Grows 10 cm. the first year. (q.v.)
2. Shape and size of face. Distinguished by small nose, and the lack of prominence in the supra-orbital ridges and the lower jaw. (q.v.)
3. Texture, color (darkening with age), and distribution of hair.
4. Teeth. (q.v.)
5. Tonsils and adenoids large.
6. Voice high-pitched. (The male voice changes at puberty.)
7. Linear relation of trunk to extremities. (See Mensuration.)
8. Circumferential relation of chest to abdomen. (See Mensuration.)
9. Skin soft. (q.v.)
10. Temperature higher and more labile. (q.v.)
11. Pulse quicker. (q.v.)
12. Respiration quicker. (q.v.)
13. Blood pressure. (q.v.)
14. Respiratory irregularity of heart.

15. Size of liver (large). (q.v.)
16. Size of spleen. (q.v.)
17. Genitalia undeveloped.

Peculiarities of Aged—

Skin—

Thinning of corium and epidermis.
Disappearance of interdigitations.
Increase of pigment in rete.
Dilatation of sweat and sebaceous glands.
Obliteration of vessels.
Disappearance of fat in connective tissue.

Result—

Yellowish color.
Seamed with furrows and wrinkles.
Dry and inelastic and thin.
Desquamated.
In folds and loose.

Wrinkles—

1. Forehead . . . } Longitudinal (long).
   } Perpendicular (short).
2. External canthus—radiating.
3. Nasolabial—down by fold from corners to mouth.
4. Transversely over neck.

Hair—Turning white.
Giving place to baldness.

Teeth—Decay, loosening, falling out.

Muscles—Waste and weaken.

Ligaments—Stretch and weaken. (Bending of back.)

Bones—Rarefied (easy to break, hard to heal).

Eye—Arcus senilis—presbyopia—cataract.

Ear—Drum—thick and dull and stiff.

Tonsils—Atrophied.

Skull—Absorption of alveolar processes.
Atrophy of maxillae.
Parietal depressions.
Angle of jaw more obtuse.
Frontal sinus larger.
Brain smaller.

Lungs—Emphysema.

Heart—Smaller and brown. $A_2 > P_2$. Extrasystoles.
Arteries tortuous.

Aorta—Small, inelastic, thick.

Arteries—Tortuous, thick, hard.

Veins—Prominent and thin.

Blood Pressure—Raised.

Epicardial Fat—Disappears.

Liver—Shrinks and brown.

Spleen—Smaller.

Kidneys—Smaller.

Prostate—Hard, enlarged.

Testicles and Penis—Smaller.

Vagina—Smaller—vault narrowed.

Gait—Slow and unsteady.

Posture—Head forward—shoulders rounded.

CHAPTER XXI

ORDER OF PHYSICAL EXAMINATION

A definite logical order should be adhered to rigidly in every physical examination.

There is no surer road to errors of omission than indifference to this point.

Some flexibility must be allowed for patients in bed and for the very ill.

The fewer the variations from the routine the better.

General Appearance

Walking into the office

1. Expression; gait; posture; behavior.

Standing

2. Height; weight; calculated ideal weight; build; musculature; nutrition; posture; color; mental state.

Constitutional Signs

Sitting

3. Body temperature; pulse at both wrists; respiration; blood pressure (systolic; diastolic).

Mental Condition

4. Perceptions; memory; orientation; attention; emotions; conduct; volition; personality; ideation.

Skin

5. Color; temperature; moisture; texture; scars; striae; desquamation; eruptions; pigmentation;

ulcers; nodules; edema; tumors; hemorrhages; superficial blood vessels; hair (distribution, color, texture, amount).

Lymph Nodes

6. Occipital; posterior auricular; anterior auricular; submental; submaxillary; parotid; superficial cervical; deep cervical; axillary; epitrochlear; pectoral; inguinal; popliteal; abdominal and bronchial.

Head

7. *Skull*—Shape; size; symmetry.

Face—

Nose—Odor; secretions; patency; adenoids.

Sinuses—Frontal; maxillary; ethmoidal; sphenoids.

Eyes—Lids; conjunctivae; corneae; irises; sclerae; pupils; fundi; movements; globes.

Ears—Hearing; discharge; tophi; mastoid tenderness; drum.

Mouth—Lips; gums; teeth; pharynx; tonsils; palate; tongue; larynx.

Neck

8. Form; pulsations; thyroid; lymph nodes; tracheal tug; esophagus.

Thorax

Sitting and Recumbent

9. Shape; symmetry; movements; size; breasts; expansion; Litten's sign; lagging.

(a) *Lungs*—Inspection.
Palpation (fremitus, expansion).
Percussion (lung borders; regional changes of note).
Auscultation. (Breath, voice, and whisper sounds—Râles.)

(b) *Pleurae*—

(c) *Mediastinum*—(D'Espine's sign; pulsations).

(d) *Heart*—
Inspection (apex beat, abnormal pulsations).
Palpation (apex; thrills; abnormal impulses).
Percussion (borders).
Auscultation (first and second sounds over four valve areas; murmurs—time, place, transmission, character).

(e) *Aorta*—
Inspection (prominence; pulsation).
Palpation (prominence; pulsation).
Percussion (widening at base).
Auscultation (murmurs).

Vessels

10. (a) Pulse (radial)—size; frequency; force; symmetry; rate; rhythm; vessel wall.
(b) Brachial.
(c) Temporal.
(d) Retinal.
(e) Varicose veins.

Abdomen

11. Inspection—form; panniculus adiposus; scars; masses; pulsations; peristalsis; circumference; umbilicus.

Palpation—tenderness; muscle resistance; fluctuation; masses; pulsation.

Percussion—for shifting dullness; to outline organs to discover air or fluid, masses.

Auscultation—peristalsis, peritoneal roughness.

(a) *Liver*—Size; position; shape; consistency; tenderness; pulsation.

(b) *Spleen*—Size; position; shape; consistency; tenderness.

(c) *Kidneys*—Size; position; mobility; tenderness (costovertebral).

(d) *Stomach*—Size; shape; position; emptying time; peristalsis; tenderness.

(e) *Intestines*—

(f) *Appendix*—

(g) *Inguinal rings*—

(h) *Anus and Rectum*—

Pelvis

12. Bladder—Palpation; percussion.
Prostate—vesicles.
Uterus—tubes—ovaries, vagina.

External Genitalia

13. Vulva, scrotum, testicle, penis.

Extremities

14. Size; length; muscles; nerves; joints; bones; tenderness.

Back

15. Tenderness; movement; rigidity; deformity; shape.

Nervous System

16. *Gait*—

Speech.

Motor functions—(muscle tone, muscle power).

Sensory functions—tactile, temperature, pain, pressure, joint sense, stereognosis.

Reflexes—

Deep—patella, Achilles, biceps, triceps, jaw, pectoral.

Superficial—ciliary, abdominal, cremasteric, plantar.

Cranial Nerves—

I. Smell.

II. Perimetry, vision, eyegrounds.

III, IV, VI. Ptosis, squint, nystagmus pupillary reflex.

V. Sensory—motor—jaw.

VII. Taste anterior 2/3 tongue.

VIII. Hearing.

IX. Taste, swallowing, reflex.

X. Phonation, lung, heart.

XI. Head movements.

XII. Move tongue.

Coordination—Romberg. Finger to finger test; diadokokinesis.

Writing—speaking.

Ankle clonus.

Sphincteric control.

Special Examinations

X-ray—Skull; ventriculography; encephalography; teeth; sinuses; thorax (heart, lungs, and mediastinum); bronchi; esophagus; stomach; intestines; ap-

pendix; gall bladder; ureters and renal pelves; bladder; air-inflated abdomen; pregnant uterus; spine; bones and joints; mastoid.

Metabolic Rate—

Vital Capacity—

Polygraphy—

Electrocardiography—

Exploratory Punctures—Brain, cord, chest, abdomen, etc.

Functional Tests—

(a) Kidney.

(b) Liver.

Biopsy—

Pharmacodynamic Tests (adrenalin, etc.)

Protein Sensitization Tests—

Animal Inoculations—

Endoscopy (bladder, rectum, vagina, trachea, bronchi, esophagus, abdomen, thorax, eye).

Collection of Material for chemical, bacteriologic, microscopic study. (Certain diagrams are useful. They should be incorporated in the record. There should be a diagram of the chest, anterior and posterior, of the heart and aorta, of the teeth, of the abdomen.)

Summary—

Discussion—

Diagnosis—

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